Central California Regional Water Recycling Project Step 1 Feasibility Study

Executive Summary For Administrative Draft Report

July 12, 1995

A Cooperative Effort funded by U. S. Bureau of Reclamation and Bay Area Water and Wastewater Agencies

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Agencies Providing Funding and In-Kind Services:

U. S. Bureau of Reclamation
Alameda County Water District
Central Contra Costa Sanitary District
City of Millbrae
City of Palo Alto
City of San Jose
Delta Diablo Sanitation District
Dublin-San Ramon Services District
San Francisco Department of Public Works
San Francisco International Airport
San Francisco Public Utilities Commission
Santa Clara Valley Water District
South Bayside System Authority
Zone 7 Alameda County Flood Control and Water Conservation District

Agencies Providing In-Kind Services:

California State Department of Water Resources
San Joaquin River Exchange Contractors Water Authority
San Luis & Delta Mendota Water Authority

D-045904

Central California Regional Water Recycling Project
Step 1 Feasibility Study
Executive Summary for
Administrative Draft Report

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Preface

This is the Executive Summary for the Administrative Draft Report. This first draft of the report has been prepared by a "Core Team" of consultants and staff from some of the participating agencies. Scoping meetings have been held to obtain input from technical committees, a regulatory agency committee, and a stakeholders committee; however, there has been no review of the document by any of the committee members. There also has been no review of the document by management or elected officials of any of the participating agencies. Therefore, the information, findings, and recommendations presented in this Administrative Draft Report have not yet been approved or endorsed by the committees or the participating agencies.

This Step 1 Feasibility Study focuses primarily on technical and economic feasibility. The feasibility of regional water recycling, relative to public acceptance, political/institutional issues, and environmental impacts will be more fully addressed in the Step 2 Programmatic EIR/EIS.

Executive Summary

The treatment and recycling of wastewater for beneficial uses represents a critical component of California's strategy to sustain a balance of water supply and demand into the future. The concept of totally recycling all municipal wastewater from the San Francisco Bay Area would produce a major new supply of water, 650,000 acre feet by the year 2020. This new supply could be utilized to reduce the projected water shortages in California and enhance the reliability of water supplied to important urban, agricultural, and environmental uses.

Brief Overview

The Central California Regional Water Recycling Project (CCRWRP) was initiated by the U. S. Bureau of Reclamation (USBR) and 15 local water and wastewater agencies to determine the feasibility of approaching water recycling in and around the San Francisco Bay Area on a regional basis. The USBR's participation was authorized by Title XVI of Public Law 102-575. The feasibility study was broken into two phases to minimize the cost of a programmatic EIR/EIS (PEIS). This Step 1 Feasibility Study focuses primarily on technical and economic feasibility. Alternatives that make it through the Step 1 screening process are then to be recommended for further evaluation of public acceptability, political/institutional viability, and environmental feasibility in a Step 2 PEIS. Results of the Step 2 PEIS will lead to final determination of feasibility and definition of a recommended project.

Local agencies in the San Francisco Bay Area have been planning water recycling projects for nonpotable uses for many years. The impetus for these projects has been a need to improve the reliability of water supplies during droughts, and, in some cases, the need to reduce the mass of trace metals being discharged to the Bay in the treated wastewater. Expected benefits from a regional recycling program include the following:

- Local recycling would be maximized.
- A major new, reliable, drought-proof source of water would be created.
- The new supply could help meet the future water needs of farms, fish, and wildlife, as well as cities.
- The regional program would provide overall improvement of water quality in the Bay/Delta environment.

Surveys of local Bay Area agencies were conducted to document recycled water demands and costs of planned local projects. Market surveys were conducted in areas of potential use outside the San Francisco Bay Area to identify levels of interest and requirements for using recycled water (see Figure ES-1). This information was presented at a series of public workshops and at meetings with potential stakeholders and regulatory agency representatives

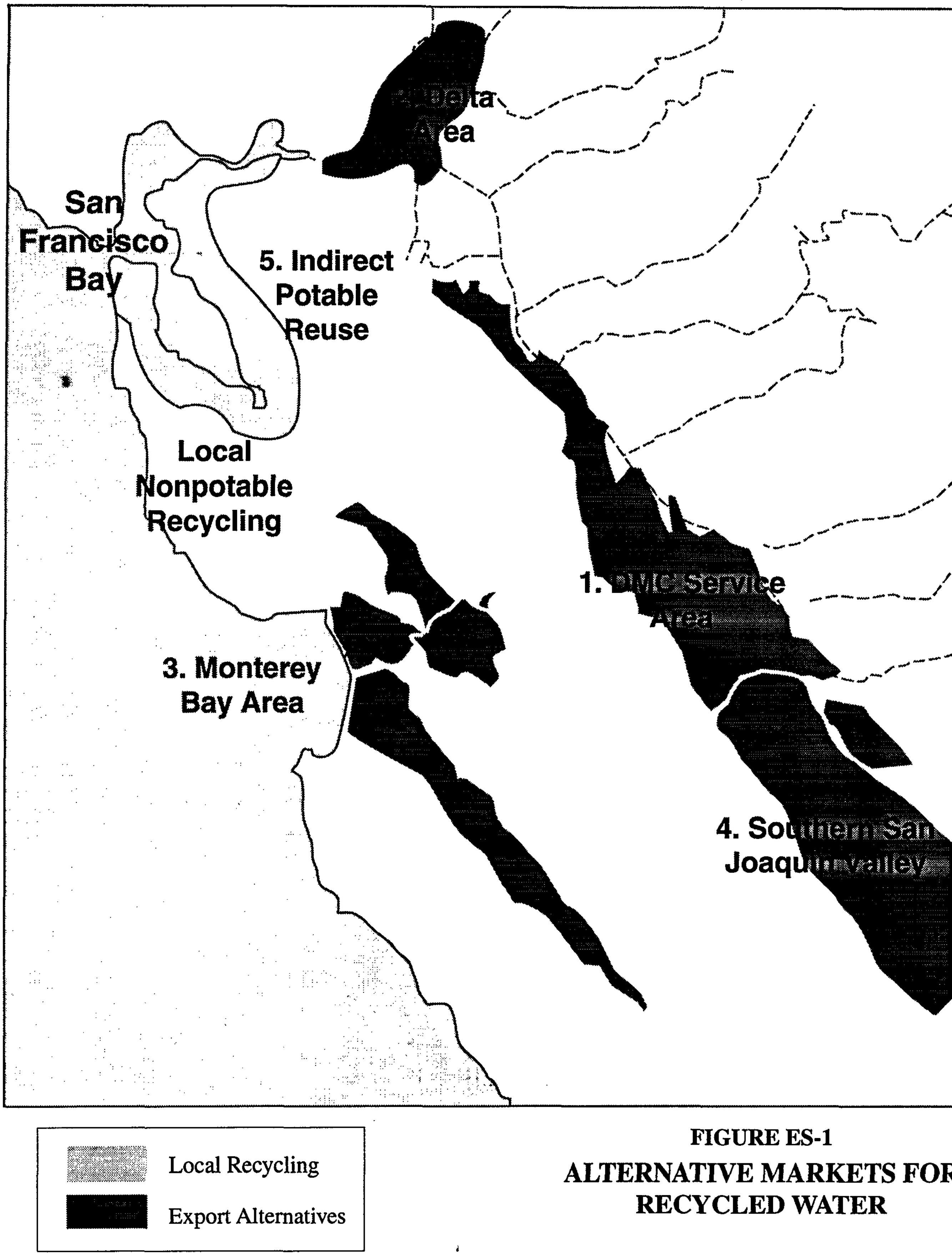

FIGURE ES-1

ALTERNATIVE MARKETS FOR RECYCLED WATER

Central California Regional Water Recycling Project

to identify key issues to be addressed. A screening study and workshop with participating agencies were then utilized to develop the following alternatives for this Step 1 Study:

1. Local Recycling and Export to the Delta Mendota Canal
2. Local Recycling and Export to the Delta Area
3. Local Recycling and Export to the Monterey Bay Area
4. Local Recycling and Export to the Southern San Joaquin Valley
5. Local Recycling and Indirect Potable Reuse
6. No Project

As indicated above, local recycling is assumed as the foundation of a regional water recycling program for all five project alternatives. Measures that should be taken to maximize local use of recycled water are described later in this Executive Summary. Various subalternatives were developed for each of the alternatives to address questions about varying places of use, storage options, levels of treatment, and management of recycled water salinity. A total of 30 subalternatives were developed for Alternatives 1-5, and four subalternatives were developed for the "No Project" alternative.

The results of this Step 1 Feasibility Study show that approaching water recycling on a regional basis does potentially make good sense for the San Francisco Bay Area. Significant water supply and effluent management benefits can be achieved with a combination of local water recycling and export of recycled water to agricultural and/or environmental uses outside the Bay Area. Four of the 30 subalternatives evaluated have been identified as potentially feasible from a technical/economic perspective:

Local Recycling and Export to the Delta Mendota Canal (Alternative 1E)

This alternative would involve upgrading all wastewater treatment plants to tertiary levels. Recycled water that cannot be utilized locally would be exported to the Delta Mendota Canal (DMC) and would be blended with Delta water for use in wildlife refuges and agricultural irrigation. During winter months recycled water would be stored in a reservoir located near Hospital Creek. During summer months recycled water would be discharged from the reservoir into the DMC below the O'Neill Forebay. Agricultural drainwater containing a mass of salts equivalent to that imported to the DMC service area would be pumped out of the San Joaquin Valley for discharge into the City and County of San Francisco's Southwest Ocean Outfall (SWOO).

Local Recycling and Export to the Delta Area (Alternative 2C)

This alternative would involve upgrading all wastewater treatment plants to tertiary levels. Recycled water that cannot be utilized locally would be exported to the Delta Area and stored in reservoirs located on Webb Tract Island and Bacon Island. During periods of low flow through the Delta, recycled water would be discharged from the reservoirs to an area near Chipps Island. The discharge of recycled water would replace upstream reservoir releases that would otherwise be necessary to control salinity intrusion into the Delta from the Bay.

Local Recycling and Export to the Monterey Bay Area (Alternative 3B)

This alternative would also involve upgrading all wastewater treatment plants to tertiary levels. Recycled water that cannot be utilized locally would be exported south of the San Francisco Bay Area for agricultural use in southern Santa Clara County, San Benito County, the Pajaro Valley, and the Salinas Valley. During winter months recycled water would be stored in a reservoir located at the Pacheco B site in southern Santa Clara County.

Local Recycling and Export to the Monterey Bay and Delta Areas (Alternative 3G)

The fourth alternative identified as potentially feasible is a combination of the second and third alternatives described above. All wastewater treatment plants would be upgraded to tertiary levels. Recycled water that cannot be utilized locally would be exported to the Delta only when there is a need for salinity repulsion. Otherwise, recycled water would be exported south to the Monterey Bay Area for agricultural irrigation. The Pacheco B site would be utilized for storage whether water is being discharged into the Delta or utilized for agricultural irrigation.

Summary

The projected water supply yields and unit costs for the four potentially feasible alternatives are summarized in Table ES-1. As noted, the yields include the 205,000 AF/y local recycling that has been projected for the year 2020. The total yields are projected to be high for all four alternatives. The exchange yields for Alternative 3B (Local Recycling and Export to the Monterey Bay Area) are relatively low, but this alternative warrants further investigation since the costs are relatively low. The unit water supply costs for all four potentially feasible alternatives are projected to be in the $1,000 to $1,200 per acre foot range, less than the cost of most other "new" supplies of water.

The Step 2 PEIS and associated studies should be pursued for these four potentially feasible alternatives. Once a recommended alternative has been defined, implementation should be phased, starting with local water recycling projects. Discussions of associated studies and project phasing are included at the end of this Executive Summary.

Local Recycling

Reports and planning documents for local water recycling projects have been reviewed and analyzed to develop projections for future use of recycled water in the San Francisco Bay Area. Water recycling projects are now planned by virtually every major water and wastewater agency in the Bay Area. The location of current and potential local water recycling projects are shown on Figure ES-2. Information about costs and cumulative yields of local recycling projects has been plotted on Figure ES-3. Some of the more expensive projects identified include the use of dual distribution systems in residential areas for the irrigation of front yard landscaping or the use of dual plumbing in existing high rises for toilet flushing. These projects

Table ES-1 Summary of Yields and Unit Costs [a] for Potentially Feasible Alternatives			
Alternatives	Total Yield [b] (AF/y)	Yield for Exchange [b] (AF/y)	Unit Cost [c] ($/AF)
Local Recycling and Export to DMC (Alternative 1E)	625,500	480,300	1,179
Local Recycling and Export to Delta Area (Alternative 2C)	630,100	630,100	1,197
Local Recycling and Export to Monterey Bay Area	658,400	246,200	1,031
Local Recycling and Export to Monterey Bay and Delta Areas	675,700	466,900	1,070

[a] Based on drought conditions.
[b] Includes 205,000 AF/y for local reuse projects.
[c] Includes $222.4 million/y for local reuse projects. Unit costs for DMC and Monterey Bay alternatives include deductions for avoided effluent management costs.

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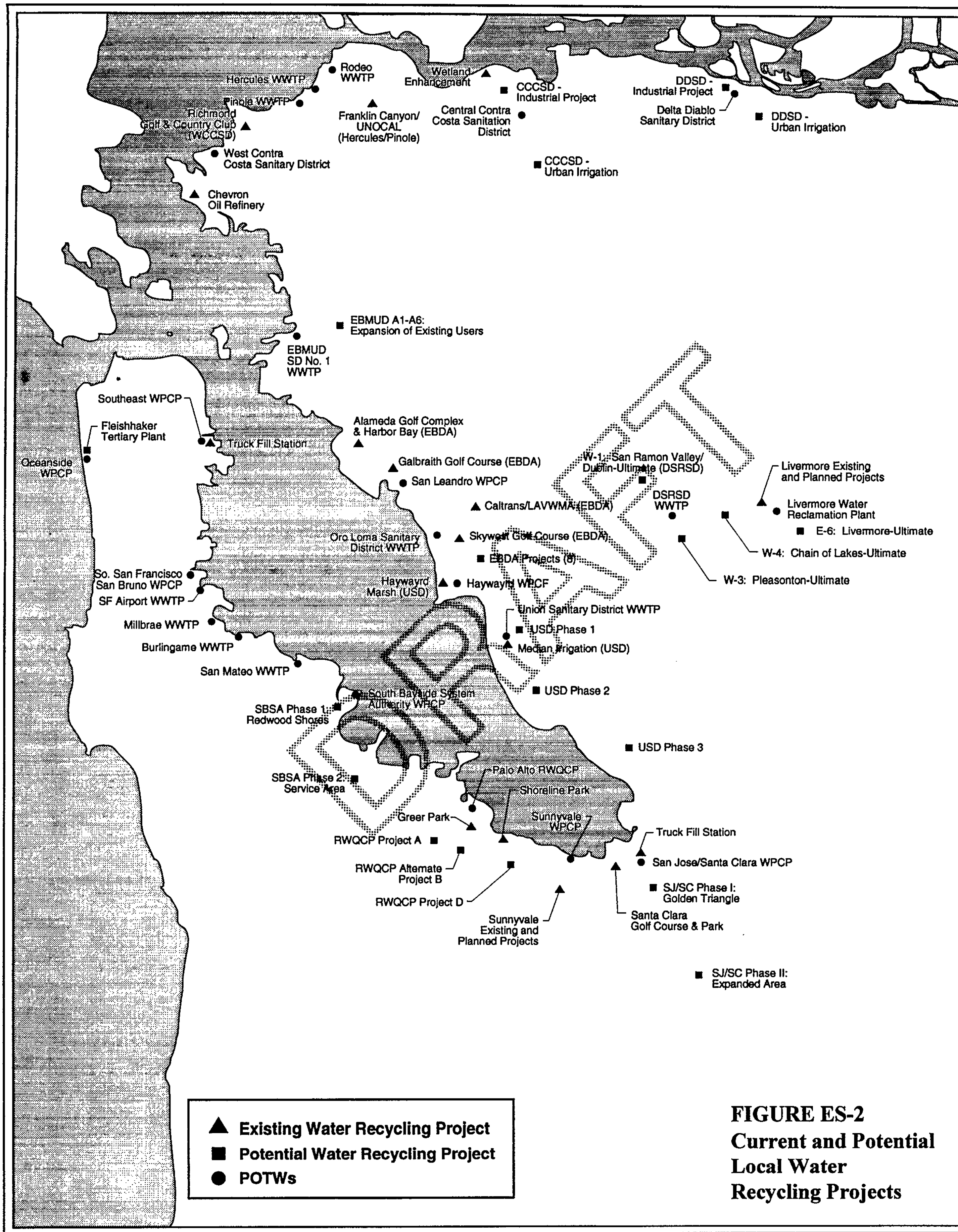

FIGURE ES-2
Current and Potential Local Water Recycling Projects

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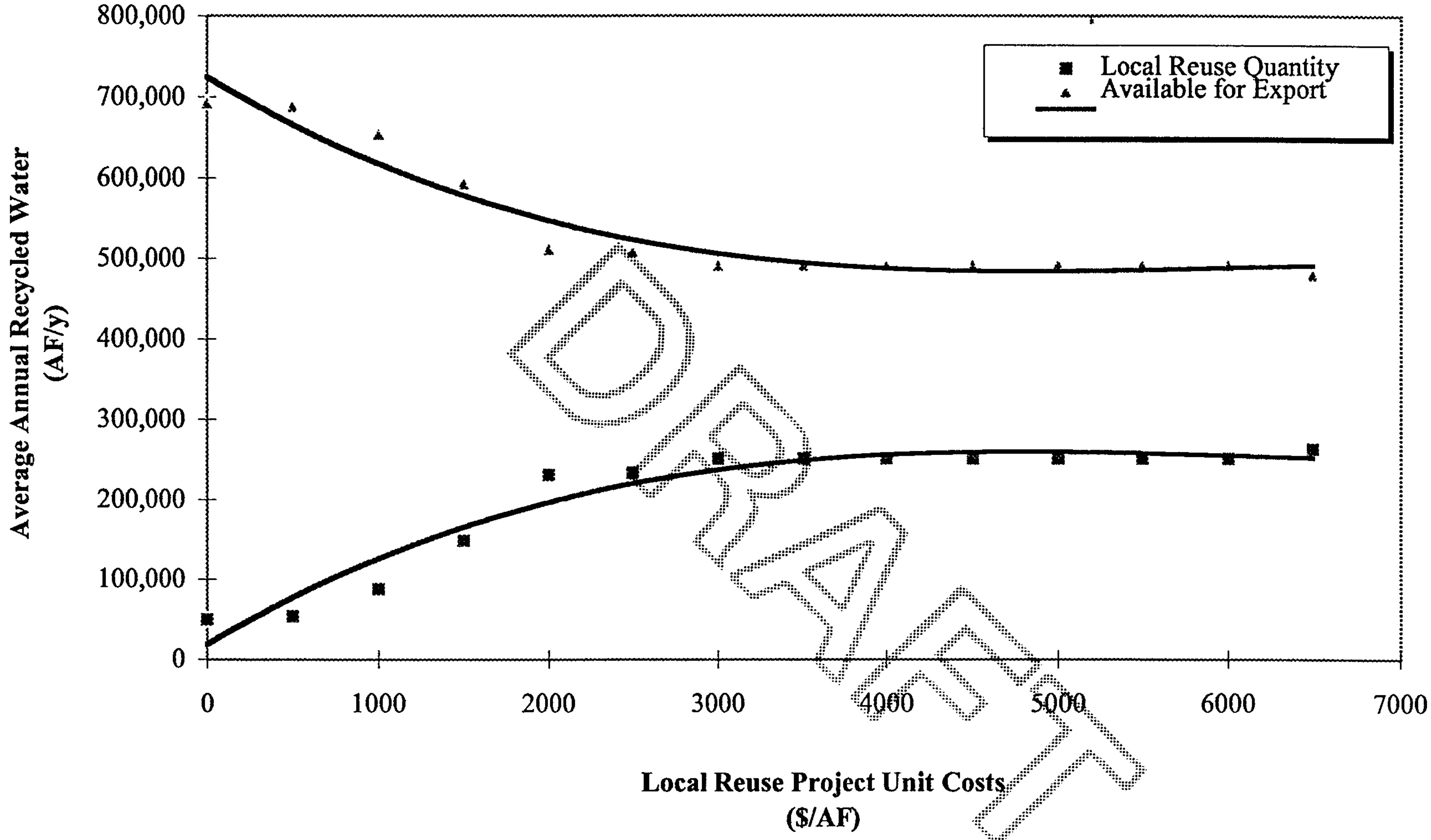

FIGURE ES-3
Local Recycling and Export Water Quantities

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typically cost greater than $3,000 per acre foot and are not presently considered cost effective by local agencies. Based on an analysis of the information shown on Figure ES-3, local recycling projects were assumed to be cost effective if their unit costs were less than or equal to $2,000 per acre foot. Using this unit cost as a general guideline, the recycled water demands were projected for the year 2020. A summary of these demands is presented by wastewater agency in Table ES-2. The average unit cost for the local recycling projects identified in Table ES-2 is estimated to be approximately $1,200 per acre foot. By approaching local recycling on a regional basis, the total annual demand of 162,000 acre feet shown in Table ES-2 is expected to increase to 205,000 acre feet by the year 2020. Measures that will ensure that local recycling is maximized to this extent include the following:

- Construction of Regional Trunk System. A regional trunk system will be necessary to connect tertiary treatment plants to one or more uses outside of the Bay Area. Such a trunk system will likely deliver recycled water to local users that would not otherwise be cost effective to serve.

- Reduction of Salinity Through Source Reduction. Cooperation between agencies to limit discharges of softener salts and to reduce inflow/infiltration (I/I) of Bay water into wastewater collection systems will significantly reduce the salinity of Bay Area recycled water. These actions will increase the local demand for recycled water.

The calculation of average annual recycled water quantities projected for the year 2020 is presented in Table ES-3. The total projected wastewater flow for Bay Area treatment plants included in this study is 658 mgd. Of this amount, approximately 70 mgd is expected to be needed to meet minimum flow requirements to the Bay for freshwater wetlands. Thus, 588 mgd (or 658,400 AF/y) is available for water recycling. As previously discussed, 183 mgd (or 205,000 AF/y) is expected to be recycled to local nonpotable uses and, therefore, 405 mgd (or 453,400 AF/y) is expected to be available for export to other uses outside the Bay Area. A plot of these projected flows by month is provided on Figure ES-4.

Extensive surveys were conducted of local agencies to determine the quality of existing and future recycled water supplies. The constituents were categorized into two groups depending on the frequency of monitoring. Group I constituents have been monitored at least monthly. Group II constituents consist primarily of organic compounds and have been monitored less frequently by the participating agencies. The weighted average of concentrations for Group I constituents is provided in Table ES-4 for Bay Area municipal treatment plants. These concentrations take into account reductions in salinity and trace metals that are expected from future source reduction and pollution prevention efforts. The concentration shown for total coliform bacteria also takes into account the assumption that all Bay Area treatment plants will be upgraded to tertiary treatment and will meet Department of Health Services (DHS) Title 22 unrestricted use requirements. Basin Plan limits are also shown in Table ES-4 for trace metals. As indicated, the combined flow from Bay Area plants will meet water quality limits where a minimum initial dilution of 10:1 is achieved. For the trace metals analyzed, however, there appears to be a potential for exceeding shallow water limits for copper and mercury. There also appears to be a potential for exceeding the Basin Plan limits for some organic compounds

Table ES-2 Currently Planned Local Nonpotable Water Recycling Projects		
Agency	Annual Water Demand	
	(AF/y)	(mgd)
San Francisco, City and County of	12,098	10.8
South Bayside System Authority	4,447	4.0
Palo Alto Regional Water Quality Control Plant	4,208	3.8
San Jose/Santa Clara Water Pollution Control Plant	37,600	33.6
East Bay Dischargers Authority (Hayward Water Pollution Control Facility, Oro Loma Sanitary District, City of San Leandro)	1,461	1.3
Union Sanitary District	4,031	3.6
Dublin-San Ramon Services District	15,725	14.0
Livermore, City of	12,500	11.2
East Bay Municipal Utility District	32,500	29.0
Central Contra Costa Sanitary District	24,976	22.3
Delta Diablo Sanitation District	12,320	11.0
Total	**162,000**	**145**

Table ES-3
Projected Annual Average Recycled Water Flow
(year 2020)

	Flow	
	(mgd)	**(AF/y)**
Total Wastewater Flow	658	-
(-) Minimum Flow to Bay	70	-
(=) Total Potential Recycled Water	588	658,400
(-) Local Recycled Water	183	205,000
(=) Recycled Water Available for Export	405	453,400

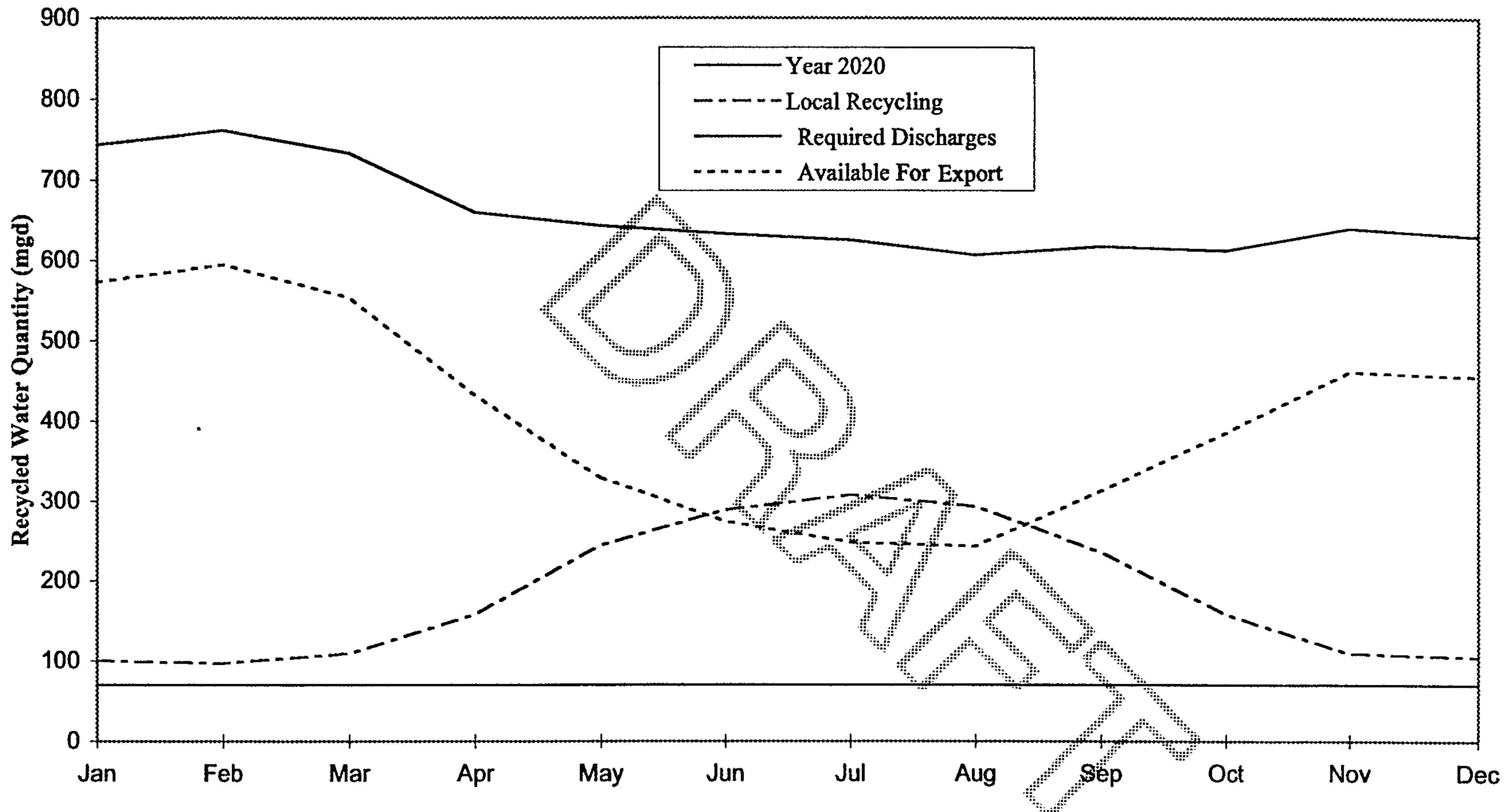


FIGURE ES-4
Estimated Recycled Water Available for Export

Table ES-4 Average Concentrations of Recycled Water Available for Export Year 2020				
Parameter	**Units**	**Level**	**Basin Plan Limit[a]**	
			Shallow Water	**Deep Water**
Group I				
Flow	mgd	405		
Turbidity	mg/L	4.5		
Total Coliforms	MPN	2.2		
Electrical Conductivity[b]	umhos/cm	1080		
Total Dissolved Solids[b]	mg/L	690		
Sodium[b]	mg/L	160		
Chloride[b]	mg/L	230		
Bicarbonate	mg/L	171		
Sulfate	mg/L	101		
Calcium	mg/L	40.2		
Magnesium	mg/L	29.2		
Potassium	mg/L	16.1		
Boron	mg/L	0.4		
Nitrate	mg/L	8.4		
Ammonia	mg/L	15.0		
Phosphorus	mg/L	4.4		
Copper[c]	µg/L	11.3	4.9	37
Silver[c]	µg/L	1.9	2.3	23
Mercury[c]	µg/L	0.18	0.03	0.21
Zinc[c]	µg/L	53.9	86	840
Lead[c]	µg/L	3.3	5.6	53
Cadmium[c]	µg/L	1.9	9.3	92
Chromium[c]	µg/L	3.9	50	500
Selenium[c]	µg/L	1.5	5	50

[a] The more stringent Basin Plan limits have been shown in this table for these parameters.

[b] Projected levels after source reduction program to reduce salinity in wastewater (see Section 9).

[c] Projected levels after pollution prevention efforts to reduce concentrations of toxic constituents (see Sections 6 and 13).

based upon current data for Group II constituents. Further analysis of place of use conditions and the composite concentrations of copper, mercury, and selected organic compounds will need to occur in the Step 2 PEIS.

After evaluation of local recycling and the projected quantity and quality of recycled water available for export, the Step 1 Feasibility Study focuses on issues that relate strictly to the export component of the regional alternatives:

- Place of Use Requirements
- Storage Options
- Salt Management

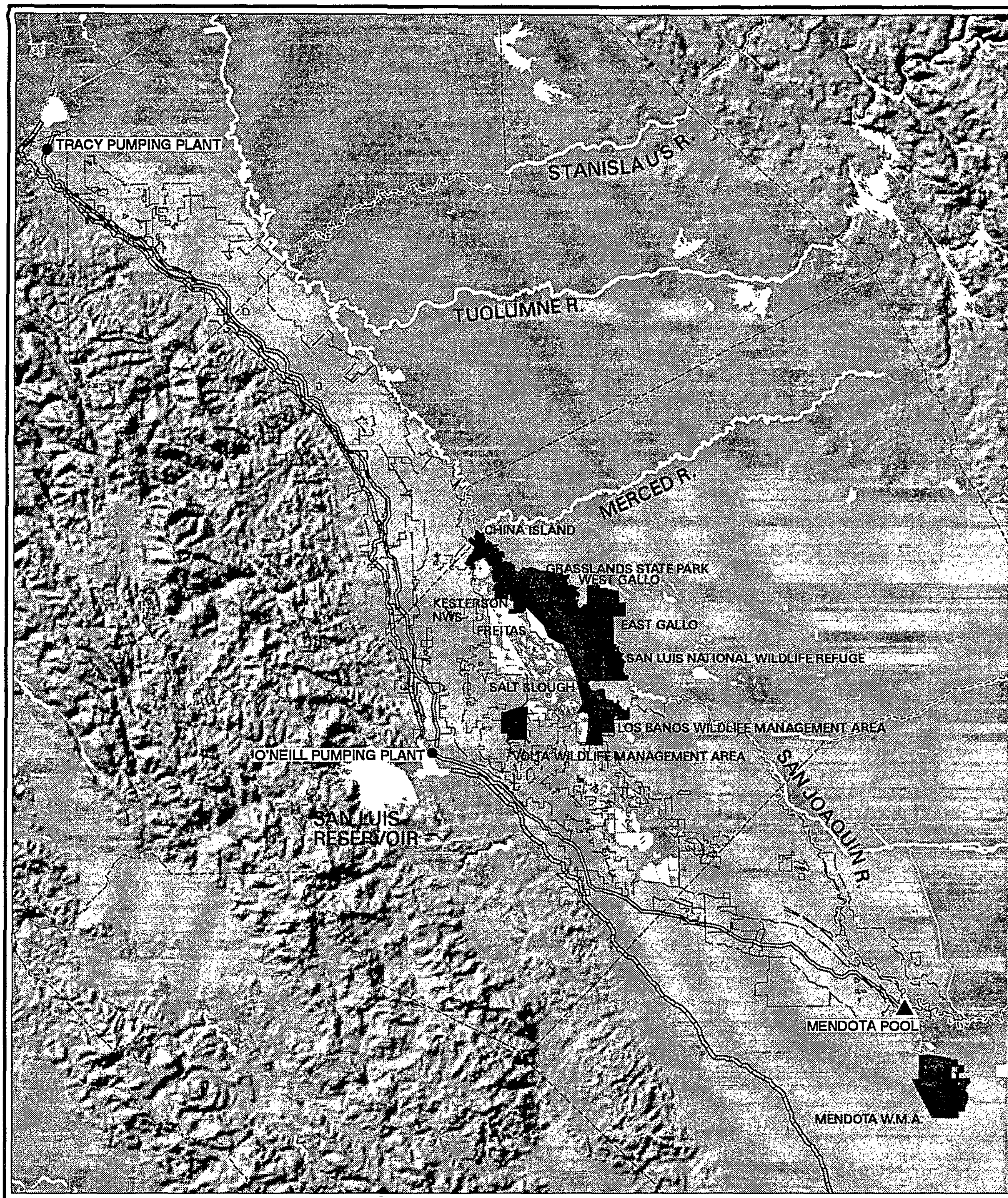
Each of these topics are covered in the following three subsections.

Place of Use Requirements

Developing alternatives for export of recycled water from the San Francisco Bay Area to Central California places of use required detailed analyses of water demands and water quality requirements in each area.

Delta Mendota Canal Service Area

The DMC was constructed by the USBR as part of the Central Valley Project (CVP) to convey water to agricultural irrigation users and wildlife refuges located south of the Sacramento-San Joaquin Delta in the San Joaquin Valley. DMC irrigation contractors include the Exchange Contractors who exchanged water rights in the San Joaquin River for priority of deliveries in the DMC. The DMC extends 117 miles from the Tracy Pumping Plant in the north to the Mendota Pool in the south. The location of these facilities and the federal and state wetland habitats that receive water from the DMC are shown on Figure ES-5. Also shown on this figure are the O'Neill Pumping Plant and the San Luis Reservoir. Excess flows in the DMC are typically pumped from the DMC into the O'Neill Forebay of the San Luis Reservoir during the months of September through February. These facilities were constructed jointly by the state and federal governments and are part of the State Water Project (SWP) as well as the CVP. Through this connection, water from the DMC can be served to the San Luis Unit of the CVP to the south of San Luis Reservoir or to the San Felipe Unit of the CVP to the west of the reservoir. Water in the DMC can be served to potable SWP users through this O'Neill connection. The DMC also provides potable water to the City of Tracy on a year-round basis. If recycled water were to be conveyed to the DMC, the point of blending would have to be downstream of Tracy's withdrawal point or an alternate potable supply would be required for Tracy. To avoid commingling of recycled water with potable supplies at the O'Neill Pumping Plant would require seasonal discharges of recycled water to the DMC (when O'Neill was not being operated) or would require discharge downstream of the O'Neill Pumping Plant. Alternatively, recycled water could be "repurified" beyond Title 22 standards, to potable drinking water standards, and then the O'Neill connection would not be of concern.



Features

- Waterbody
- Wildlife Refuges
- *Pump Stations*
- County Boundaries
- State Water Project
- Delta-Mendota Canal
- DMC Service Area

0 2 4 6 8 10
MILES

FIGURE ES-5
WILDLIFE REFUGES IN THE DMC SERVICE AREA

Central California Regional Water Recycling Project

/gis4/ccrwrp/figs_1/fig7-3.AML - July 10, 1995

The total annual water demand for the entire DMC service area is approximately 1820 thousand acre feet (TAF) and the demand downstream of O'Neill is almost 1430 TAF per year. The annual water demands for wildlife refuges from the DMC are approximately 330 TAF. The evaluation of blending recycled water with Delta water in the DMC was conducted utilizing information from work being done on the Central Valley Project Improvement Act (CVPIA) PEIS, USBR's "Project Simulation" (or PROSIM model), and a spreadsheet model developed for this study. Details of these analyses are provided in Section 14 and Appendix J of this Administrative Draft Report.

The water quality requirements for water used in the DMC service area are summarized in Tables ES-5 and ES-6. Table ES-5 presents guidelines for irrigation water quality and Table ES-6 presents proposed water quality standards for wildlife refuges. The projected salinity of recycled water (after source reduction) will be slightly greater than the values shown in the "No Problems" category of Table ES-5. However, since this alternative assumes blending with Delta water, there should not be any detrimental effects using recycled water for irrigation in the DMC service area. In general, it appears that recycled water blended with Delta water will meet proposed objectives for wildlife refuges. As indicated by the values shown in Table ES-6, there may be a problem with both Delta water and recycled water in meeting proposed objectives for mercury. This constituent may be a candidate for a watershed management approach to reducing ambient levels in the Sacramento and San Joaquin River systems. The values shown in Table ES-6 also indicate that there may be a problem with high levels of ammonia in the recycled water, depending on the ratio of the blend of Delta water to recycled water. Further assessment of this issue is warranted, but it is likely that most of the ammonia would be transformed to nitrate and nitrite forms of nitrogen if a surface reservoir is utilized for storage of recycled water.

Delta Area

Two separate places of use have been studied in the Delta Area as part of the CCRWRP. One use would be discharge near Chipps Island for salinity repulsion and the other would be agricultural irrigation of several Delta Islands. The Delta was created by the confluence of the Sacramento, San Joaquin and other smaller rivers. On the average, about 21 million acre feet of fresh water reaches the Delta annually, but actual inflow varies widely from year to year and within the year. On a seasonal basis, average natural flow to the Delta varies by a factor of 10 between the highest month in winter or spring and the lowest month in fall. Assuming the latest flow restrictions during normal water years, about 10 percent of the water reaching the Delta would be withdrawn for local use, 30 percent would be withdrawn for export by the CVP and SWP, 20 percent would be needed for salinity control, and the remaining 40 percent would become Delta outflow in excess of minimum requirements. The excess outflow would occur almost entirely during the winter and spring seasons of high inflow.

Due to the complex operations of the Delta, the potential recycled water demands for salinity repulsion are difficult to estimate. The demands and corresponding yields depend on the following variables:

- Water releases from upstream USBR facilities

Table ES-5
Irrigation Water Quality Guidelines Versus Recycled Water and DMC Water Qualities

Potential Irrigation Problem & Related Constituents	Acceptable Guidelines			Projected Recycled Water Quality[c]	Existing DMC Water Quality	
	No Problems	Increasing Problems	Severe Problems		Tracy Pumping Plant	O'Neil Pumping Plant
Salinity						
Electroconductivity (EC), dS/m	<0.75	0.75-3.0	3.0-7.5	1.08	0.54	0.65
TDS, mg/L[a]	500	500-2000	2000-5000	690	325	364
Permeability						
Adj. SAR	<6.0	6.0-9.0	>9.0	4.8	N/A	N/A
Specific Ion Toxicity						
From root absorption						
Sodium, Adj. SAR	<3.0	3.0-9.0	>9.0	4.8	N/A	N/A
Chloride, mg/L	<140	140-350	>350	230	81	115
Boron[b], mg/L	<0.5	0.5-2.0	2.0-10.0	0.4	0.64	0.22
From foliar absorption						
Sodium, mg/L	<70	>70	-	160	78	76
Chloride, mg/L	<100	>100	-	230	81	115
Nutrients						
Nitrogen, mg/L	<5.0	5.0-30.0	>30.0	24	N/A	N/A

[a] No problem - No detrimental effects are usually noticed.
Increasing problems - At TDS of 500-1000 mg/L, water can have detrimental effects on sensitive crops. At TDS of 1000-2000 mg/L, water can have detrimental effects on sensitive crops. Careful management practices are required.
Severe Problems - Water can be used only on tolerant plants on permeable soils with careful management practices.
[b] No Problem - Satisfactory for all crops.
Increasing Problems - At 0.5 - 1.0 mg/L, satisfactory for most crops; sensitive crops may show leaf injury but yields may not be affected. At 1.0 - 2.0 mg/, satisfactory for semi-tolerant crops. Yield and vigor of sensitive crops are usually reduced.
Severe Problems - At 2.0 - 10.0 mg/L, only tolerant crops produce satisfactory yields.
[c] Unblended recycled water after implementation of salinity reduction measures (see Section 9).

Table ES-6 Proposed Refuge Water Quality StandardsVersus DMC and Recycled Water Qualities (mg/L)			
Constituents	**USFWS Water Quality Objectives [a]**	**Existing DMC Water Quality at Mendota Pool Water Quality [b]**	**Projected Recycled Water Quality [c]**
Aluminum	5.0		0.2
Antimony	1.6		0.06
Arsenic	0.19	<0.004 - <0.05	0.0014
Beryllium	0.0053	<0.001 - <0.014	0.0034
Boron	0.750	0.15 - 0.9	0.4
Cadmium	0.001	<0.0001	0.0021
Chromium	0.011	0.001 - <0.012	0.0043
Cobalt	0.05		0.017
Copper	0.012	0.004 - 0.0074	0.0126
Iron	1.0		0.21
Lead- dissolved	0.0025	<0.001 - 0.004	0.0037
Manganese	0.2		0.039
Mercury	0.000012	0.00020 - <0.00032	0.0002
Molybdenum	0.019	<0.005 - <0.020	0.021
Nickel	0.16	<0.02 - <0.050	0.0076
Selenium	0.002	0.001 - 0.003	0.0017
Silver	0.0041	<0.0001 - <0.0010	0.0021
Thallium	0.04	<0.001 - <0.04	0.014
Vanadium	0.1		0.015
Zinc	0.11	0.004 - 0.028	0.06
TDS	450.0	160 - 511	690
Ammonia	2.2		15

Sources:

[a] Provided by the U.S. Fish and Wildlife Service (USFWS). See Table 7-5 footnotes (a) and (c) for information on data source.

[b] Provided by USBR and Delta Mendota & San Luis Water Authority. Presented are a range of measured concentrations from May 4, 1993 to May 4, 1994. Data were not available for all parameters.

[c] Unblended recycled water quality after implementation of source reduction measures.

- Monthly operations of the Delta and export facilities
- Salinity of the recycled water
- Water quality criteria of the Delta
- Storage availability

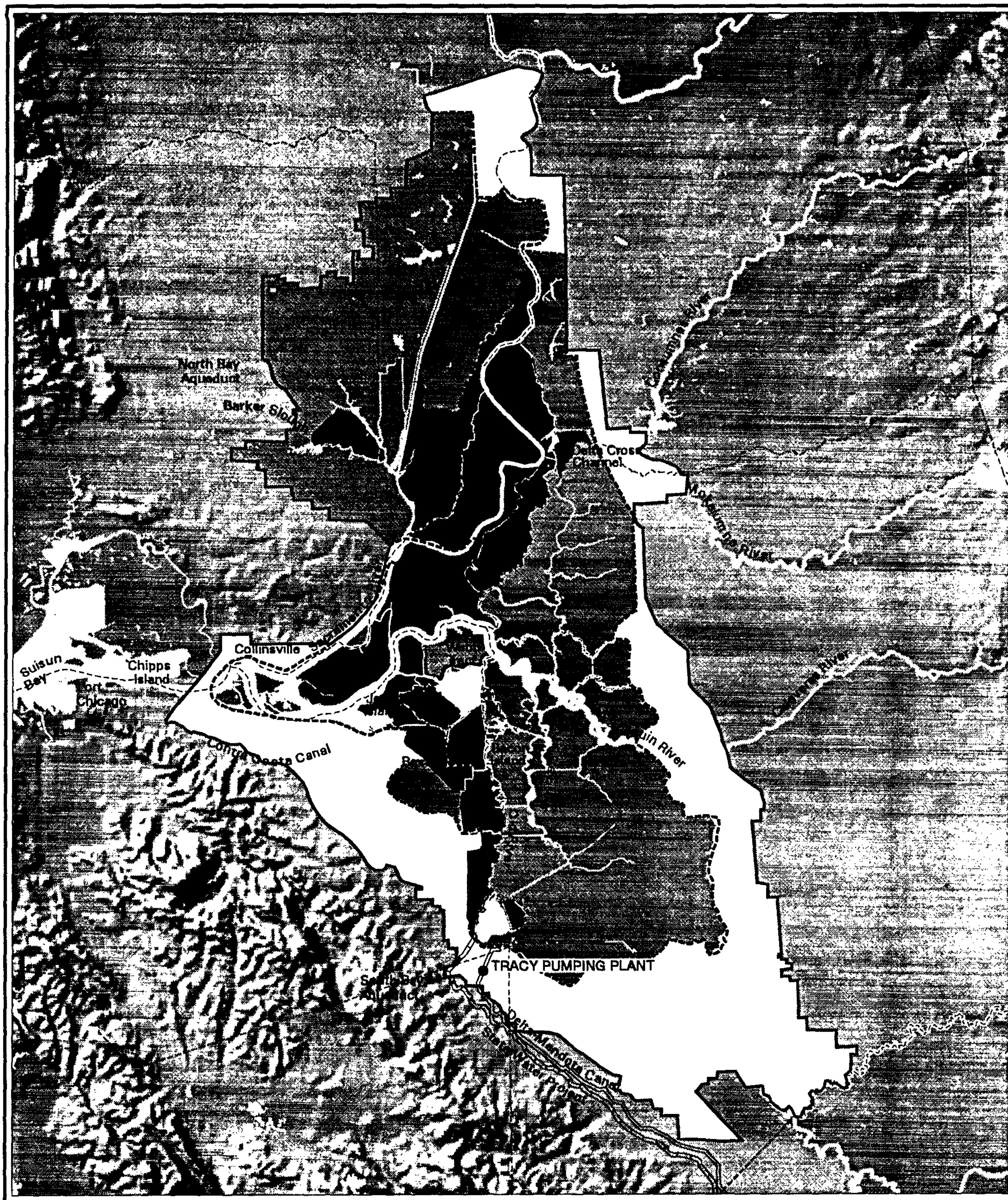
In order to take all of these parameters into consideration, computer modeling of the Delta with recycled water was performed based on PROSIM output. Details of the computer modeling are described in Section 15 and Appendix J of this report. The modeling assumptions used are very preliminary and should be studied in more detail in the PEIS phase of the project.

The consumptive use of water for agricultural irrigation in the Delta has been projected to be about 450,000 AF/y by the year 2020 by the Department of Water Resources (DWR) Bulletin 160-93. The use of recycled water for irrigation of the Delta Islands may be precluded by recent actions taken by the Delta Protection Commission and San Joaquin County to restrict importation of "sewage effluent" to the Delta Area. A potential service area for use of recycled water has been developed on islands outside San Joaquin County for purposes of this study. This potential service area and Delta Area boundaries are shown on Figure ES-6. The yearly demands for irrigation water in the service area shown on Figure ES-6 would be about 230,000 AF/y in an average year.

A draft of a new Water Quality Control Plan for the Delta was issued jointly by the U. S. Environmental Protection Agency (EPA) and State Water Resources Control Board (SWRCB) on December 15, 1994. This plan provides for the protection of the estuary's beneficial uses by addressing salinity (from saltwater intrusion and agricultural drainage) and water project operations (flows and diversions), as well as establishing a dissolved oxygen objective. The requirements of this plan were incorporated into the assumptions made in the PROSIM runs completed for the salinity repulsion place of use option. Future water quality requirements for toxic constituents in the Delta are likely to be similar to the requirements presented in Table ES-6 for refuge water supplies. The quality of Delta water is also likely to be similar to the quality of water shown in Table ES-6 for the DMC at the Mendota Pool. Therefore, as previously discussed for the DMC place of use, there will likely be a problem meeting water quality requirements for mercury in the Delta, with or without the use of recycled water.

Monterey Bay Area

This export alternative would involve the transport of recycled water from the San Francisco Bay Area to the Monterey Bay Area for use in agricultural irrigation. The places of use would include southern Santa Clara Valley, San Benito County, the Pajaro Valley of Santa Cruz County, and the Salinas Valley of Monterey County. The locations of these areas are shown on Figure ES-7. The total average annual irrigation demand for these areas is approximately 670,000 acre feet as indicated in Table ES-7. The local recycled water supply in these areas is about 50,000 AF/y. Thus, there is a potential available recycled water demand of approximately 620,000 AF/y, compared to approximately 450,000 AF/y recycled water available for export from the San Francisco Bay Area by the year 2020.



Features

- The Legal Delta Boundary
- Delta Primary Zone Boundary
- Irrigation Service Area
- Delta Primary Zone
- Delta Secondary Zone
- Pump Stations
- County Boundaries
- State Water Project
- Delta-Mendota Canal

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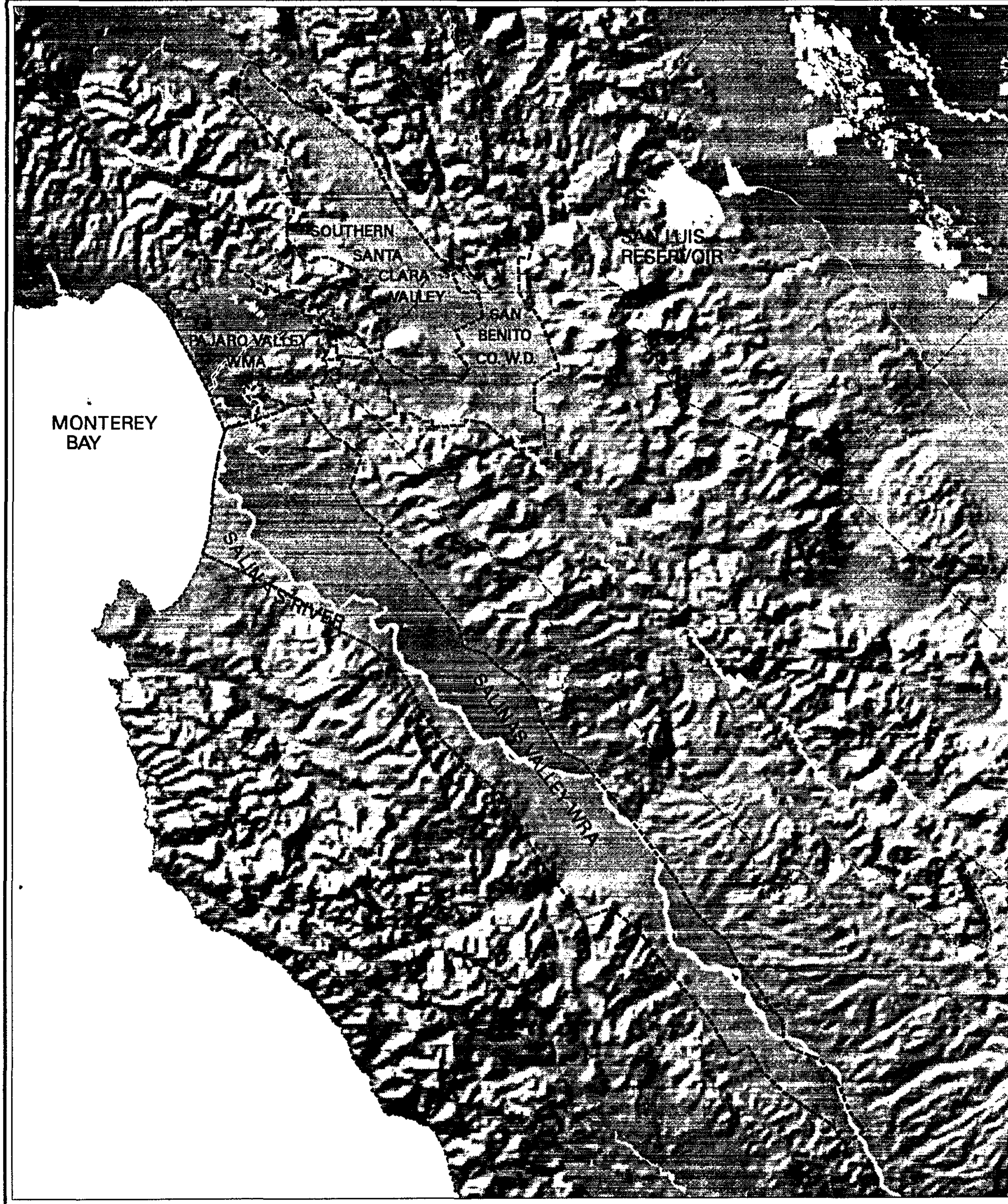
FIGURE ES-6
DELTA ISLAND IRRIGATION SERVICE AREA

Central California Regional Water Recycling Project

/gis4/corwrp/figs_1/fig7-5.AML - July 10, 1995



Features

- Waterbody
- County Boundaries
- Water Districts

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FIGURE ES-7

MONTEREY BAY SERVICE AREA

Central California Regional Water Recycling Project

/gis4/ccrwrp/figs_1/fig7-6.AML · July 10, 1995

Table ES-7 Monterey Bay Area Annual Agricultural Irrigation Water Demands, Acre-feet									
	Santa Clara Valley Water District		Pajaro Valley WMA		San Benito County WD		Salinas Valley		Total
	Current[a]	Year 2020	Current[b]	Year 2020	Current[c]	Year 2020[d]	Current[e]	Year 2020	Year 2020
Annual Demand	70,500	45,000	52,200	64,360	39,046	39,046	510,000	525,300	673,706

[a] Water Year 1992-1993.
[b] 1989.
[c] Average of water use from water years 1980-81 to 1992-93.
[d] Future demands are not available. The Year 2020 demands are assumed to equal current demands.
[e] 1991.

A comparison of projected recycled water quality available for export versus existing water quality in the Monterey Bay Area is provided in Table ES-8. Based upon the information available, it does appear that the salinity of recycled water will be slightly higher than existing water supplies. Further study of this issue should be conducted in the Step 2 PEIS to determine the effect of the projected salinity levels on crops in the area and the potential for blending recycled water with groundwater or other available supplies.

Southern San Joaquin Valley

The Southern San Joaquin Valley place of use would include the irrigation districts served by the San Luis Unit of the CVP. These districts are the Panoche Water District, Pleasant Valley Water District, San Luis Water District, and the Westlands Water District. The historic average annual water usage for this area totals about 1.5 MAF, of which about 0.25MAF comes from groundwater and the rest from the DMC or the San Luis Canal. The supply of water from CVP sources typically has had the levels of quality presented in Table ES-5 for the DMC. The groundwater supplies typically are saltier, with TDS values in the range of 700 to 2000 mg/l.

Indirect Potable Reuse

This alternative would allow all recycled water generated in the San Francisco Bay Area to be utilized locally. Local nonpotable recycling would be maximized as with the four export alternatives, but recycled water not utilized for nonpotable purposes would be "repurified" to DHS standards and then blended into the water supply reservoirs of the San Francisco Bay Area. A draft DHS policy was developed for a similar concept being studied by the San Diego County Water Authority. This draft policy sets requirements for source water and initial treatment, water purification treatment plants, and reservoir management programs. The level of treatment requires reverse osmosis (RO) as a minimum. The reservoir management program requires a 12-month hydraulic detention time for repurified water blended into water supply reservoirs.

Storage Options

The peak water demands of the irrigation alternatives will typically occur during late spring and summer. The peak water demands of the Delta salinity repulsion alternative will typically occur during the late summer and fall. As previously shown by Figure ES-4, however, these are also the periods of time when local recycled water demands are the greatest, and when there is the least amount of recycled water available for export. Therefore, storage will need to be incorporated into the export alternatives in order to maximize water supply yield and minimize effluent discharges to the Bay.

In response to suggestions received during the scoping/screening phase of this study, both above ground and below ground storage options have been considered. An exhaustive literature search of records from state and federal agencies led to the identification of approximately 90 surface reservoir sites. A similar literature search of groundwater basins led to the identification of about 20 aquifers in Northern and Central California.

Table ES-8 Recycled Water Quality Versus Existing Monterey Bay Area Water Quality				
		Existing Monterey Bay Water Quality[a]		
Potential Irrigation Problem & Related Constituents	Projected Recycled Water Quality	South Santa Clara County Ground Water[b]	Pajaro Valley WMA Ground Water[c]	Salinas Valley Ground Water[d]
Salinity				
Electroconductivity (EC), dS/m	1.08	0.82	0.89	0.7
TDS, mg/L	690	469	N/A	413
Permeability				
SAR	4.8	N/A	N/A	N/A
Specific Ion Toxicity, mg/L				
Sodium	160	43	58	60
Chloride	230	56	55	104
Boron	0.4	0.2	N/A	0.08

Notes:
[a] San Felipe Unit water and San Benito County WD groundwater quality were not available.
[b] Ground water quality data average for 14 weeks from 11/91 - 7/94.
[c] Ground water quality data average for five weeks from 10/91 - 4/94.
[d] Median ground water quality data from 8/80 - 6/85.

A preliminary screening of potential surface reservoir sites was conducted based upon location relative to the places of use being studied, storage capacity, ratio of embankment volume to reservoir capacity, and regulatory/environmental issues. After this screening step, 20 surface reservoir sites remained as potentially feasible. These 20 sites (including two in the Delta Islands) are listed in Table ES-9 along with maximum capacities and applicable export alternatives. The locations of potential reservoir sites, in relation to major fault lines, are provided on Figure ES-8.

The locations of potential storage aquifers are presented on Figure ES-9. These sites were screened based upon criteria such as capacity, overdraft conditions, and existing groundwater quality. An ideal aquifer for storage of recycled water would be one that is overdrafted with quality similar to that of recycled water. Aquifers designated as potable water supplies would require RO treatment of recycled water and strict requirements for injection according to proposed DHS requirements. The aquifers identified as potentially feasible for the export alternatives are listed in Table ES-10. Basins identified as Tier 1 would be the best candidates for groundwater storage of recycled water, with overdraft conditions and water quality similar to recycled water. Those basins identified as Tier 2 in Table ES-10 have water quality similar to recycled water, but are not currently overdrafted.

Salt Management

Maximizing local use of recycled water and export to uses outside the San Francisco Bay Area requires management of salt load in the recycled water. The approach taken in this study with respect to salt management was to first assess the reduction in salt concentration that could be achieved through source control and to assess the viability of dealing with the remaining salt load through three methods:

- Prevention through RO treatment
- Mitigation through solutions at the place of use
- Mitigation through agricultural drainwater disposal

The primary source of salt in wastewater in the Bay Area is Bay water I/I. There is also a significant amount of salinity increase due to the discharge of softener salts to wastewater collection systems in some parts of the Bay Area. The focus of source control efforts in this study has been Bay water I/I. Seven participating agencies with TDS concentrations greater than 500 mg/l and effluent flow rates greater than 10 mgd were evaluated. One of these agencies, the City and County of San Francisco, has been conducting an I/I study, as part of this Step 1 Feasibility Study, to assess the potential for reducing salts in their Southeast Water Pollution Control Plant (SEWPCP). Based upon preliminary results from the SEWPCP study and data obtained from the other six agencies, projections were made about salt reductions expected by the year 2020. Based upon these projections, the total overall salinity of Bay Area recycled water is expected to decrease from the current level of 900 mg/l down to 690 mg/l. As previously discussed, this salinity level may be acceptable for uses identified in the Delta and Monterey Bay areas, but further reductions in salt load were assumed necessary for

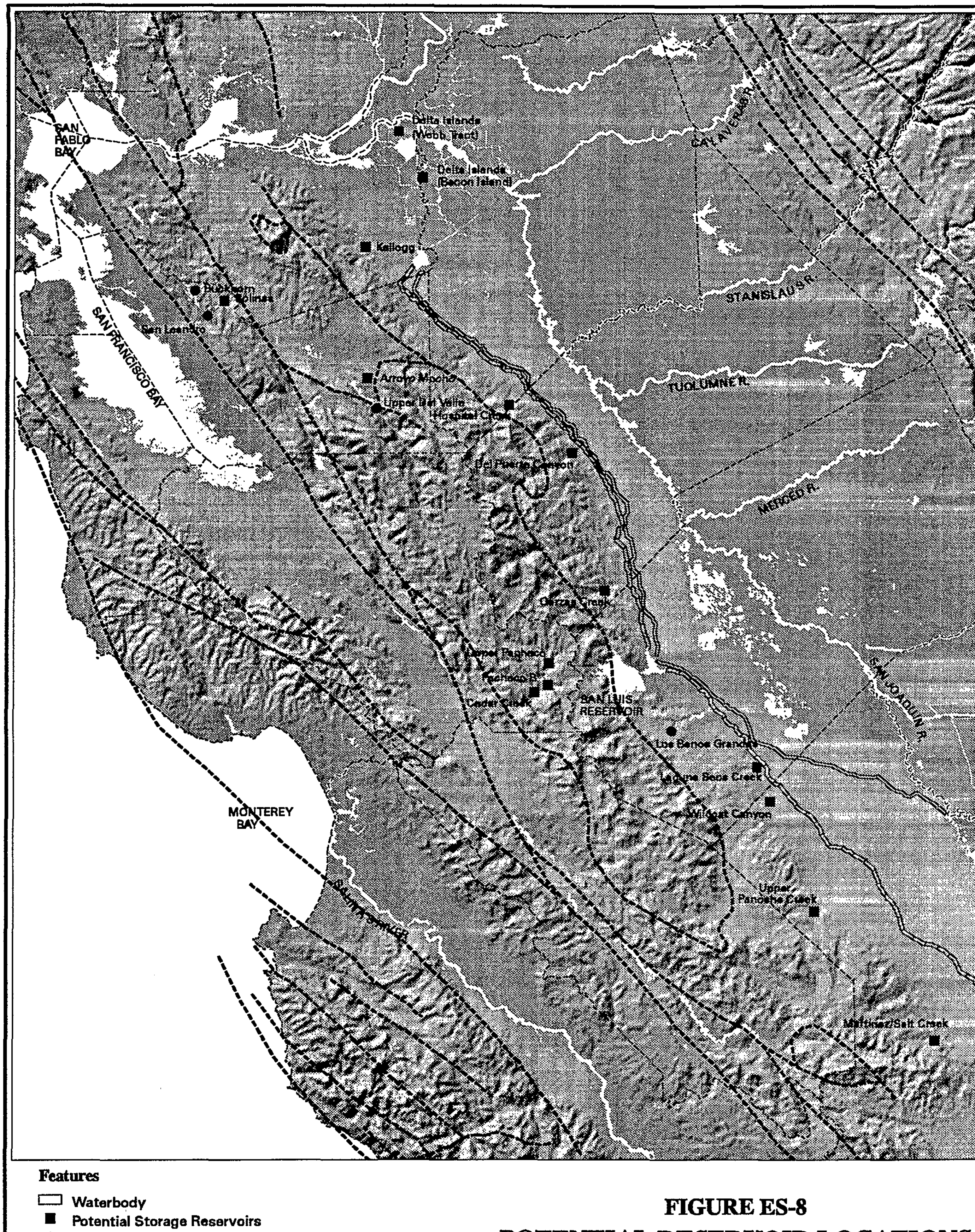
Table ES-9
Potential Reservoir Sites for Export Alternatives

Reservoir Site	County	Capacity[a] (TAF)	Alternative 1 DMC	Alternative 2 Delta Area	Alternative 3 Monterey Bay Area	Alternative 4 S. San Joaquin	Alternative 5 Indirect Potable Reuse
Arroyo Mocho	Alameda	120					◆
Bolinas	Alameda	57		◆			◆
Buckhorn[b]	Alameda	150					◆
Cedar Creek	Santa Clara	177			◆		
Del Puerto Canyon	Stanislaus	100	◆			◆	
Delta Islands	CC/SJ	238		◆			
Garzas Creek	Stanislaus	340	◆			◆	
Hospital Creek	San Joaquin	432	◆			◆	
Kellogg	Contra Costa	120		◆			◆
Laguna Seca Creek	Merced	282				◆	
Los Banos Grandes[c]	Merced	1728				◆	
Martinez/Salt Creek	Fresno	494				◆	
Pacheco B	Santa Clara	400			◆		
Pinole	Contra Costa	68		◆			◆
San Leandro[b]	Alameda	51					◆
Upper Del Valle[b]	Alameda	120					◆
Upper Pacheco	Santa Clara	350			◆		
Upper Panoche Creek	Fresno	316				◆	
Wildcat Canyon	Merced/Fresno	95				◆	

[a]Capacities shown are the maximum capacity evaluated in previous study.

[b]Reservoir site is located upstream of existing potable water supply reservoir.

[c]Los Banos Grandes is larger than the maximize size allowed by the screening criterion and is located upstream of an existing potable water supply reservoir. This site, however, is included in this table for consideration as a combined project with the Department of Water Resources



Features

- Waterbody
- ■ Potential Storage Reservoirs
- ● Potential Storage Reservoirs (Upstream of Existing Watershed)
- County Boundaries
- State Water Project
- Delta-Mendota Canal
- Major Faults

N

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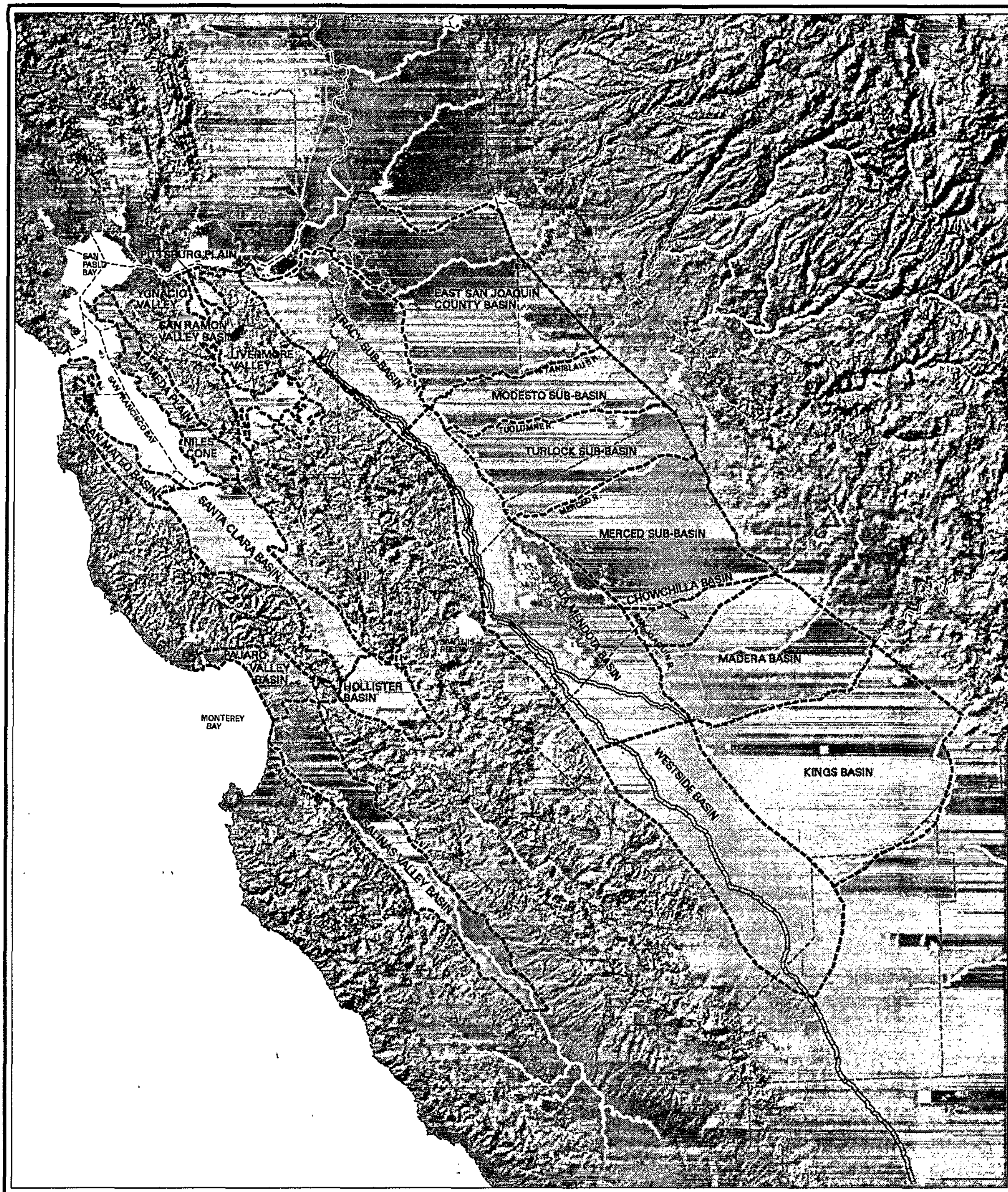
FIGURE ES-8
POTENTIAL RESERVOIR LOCATIONS WITH FAULT LINES

Central California Regional Water Recycling Project

/gis4/ccrwrp/figs_1/FIG8-2.AML - July 10, 1995



Features

- Waterbody
- Aquifers
- County Boundaries
- State Water Project
- Delta-Mendota Canal

FIGURE ES-9
AQUIFER STORAGE LOCATIONS

Central California Regional Water Recycling Project

/gis4/ccrwrp/figs_1/FIGS-3.AML - July 10, 1995

Table ES-10 Groundwater Basin Candidates for Export Alternatives			
Alternative		Potential Groundwater Basins	
No.	Description	Name	Tier
1	DMC	Tracy Sub-Basin	2
		San Ramon Valley	2
2	Delta Area	Tracy Sub-Basin	2
		San Ramon Valley	2
		Ygnacio Valley	2
		Clayton Valley	2
3	Monterey Bay Area	Pajaro Valley	1
		Salinas Valley	1
4	South San Joaquin Valley	Tracy Sub-Basin	2
		Delta-Mendota Sub-Basin	2
		Westside	1
5	Indirect Potable Reuse	San Ramon Valley	2
		Ygnacio Valley	2
		Clayton Valley	2

alternatives delivering recycled water to the San Joaquin Valley. Various combinations of the three methods listed above were included in the San Joaquin Valley subalternatives. In all cases, the assumption was made that a salt load equivalent to that exported to the Valley would have to be prevented with RO treatment or mitigated by agricultural drainage solutions.

The use of RO treatment to eliminate salts before export would likely achieve a 90 to 95 percent reduction of TDS at a recovery rate of 85 percent. This means that 15 percent of the flow would end up as a brine. Two alternatives for brine disposal were considered in this study, evaporation and ocean discharge. Once evaporation occurred, the dewatered brine would be transported to a landfill for final disposal. For the ocean discharge option, the SWOO was assumed to be the outfall used for ocean discharge of brine.

The sources and movement of salts in the San Joaquin Valley are depicted on Figure ES-10. The major sources of salts are dissolution in native soil and rocks and the import of water from the Delta. Salt management has been recognized as a critical issue for the San Joaquin Valley since the 1950's. Planning for construction of a master drain first began in 1957 and the San Luis Drain was constructed as far north as the Kesterson Reservoir by the late 1960's. Plans for extending the drain north to the Delta were halted in the 1980's when it was discovered that selenium in the drainage water had caused deformities and deaths of aquatic birds at Kesterson. The San Joaqin Valley Drainage Program (SJVDP), a joint federal/state effort, was established in 1984, and in 1990 the SJVDP issued a report which emphasized initial mitigation of drainage problems with in-Valley solutions. A summary of the disposal options recommended by the SJVDP for the DMC service area and Southern San Joaquin Valley are presented in Table ES-11. Implementation of many of these options has been initiated. For this study, mitigation through in-Valley salt management has assumed the construction of a system of tile drains, drainage collectors, evaporation ponds, and a landfill to handle the quantity of salt imported with recycled water.

The third method evaluated in this study for handling salts (beyond source control) has been mitigation through agricultural drainage water disposal. Input has been obtained from representatives of the SWRCB and the Central Valley and Bay Area Regional Water Quality Control Boards on this issue. Based upon this imput, drainage water disposal to the Pacific Ocean has been evaluated in this study, but drainage water disposal to the Delta or San Francisco Bay has not be considered. A summary of the projected water qualities of agricultural drainage water and RO treatment brine versus Ocean Plan limitations is provided in Table ES-12. Based upon this information, the agricultural drainage water quality meets Ocean Plan limitations for all constituents except chromium without considering dilution. Limitations for chromium could be met with a dilution of approximately 7:1. For brine generated by RO treatment of Bay Area wastewater, a dilution of approximately 80:1 would be required to meet the Ocean Plan criteria for copper. In addition to meeting numerical requirements for toxic constituents listed in the Ocean Plan, the discharges of either drainage water or RO brine would be required to meet specified toxicity limitations based on bioassays of appropriate marine test organisms.

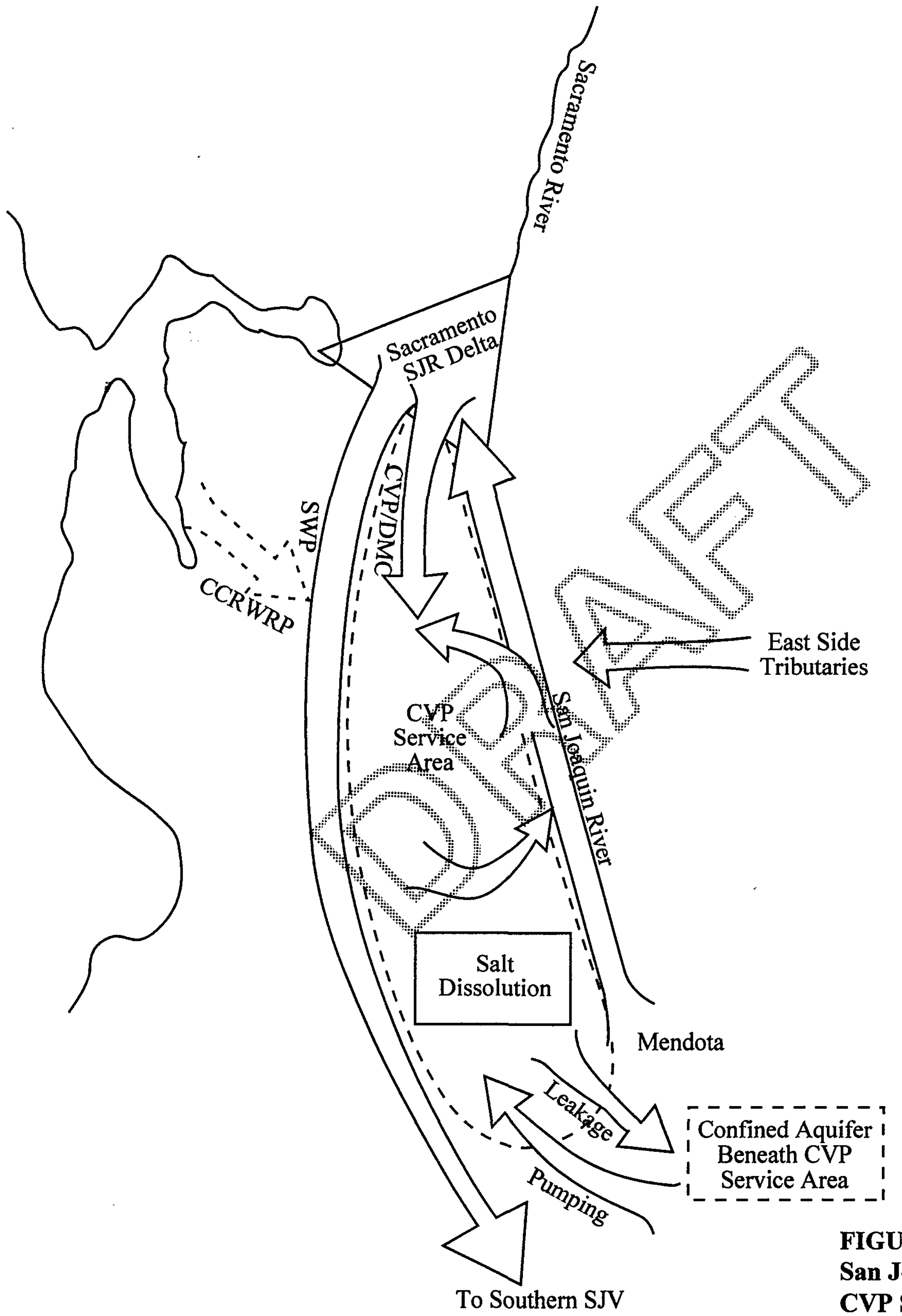


FIGURE ES-10
San Joaquin Valley/
CVP Service Area
Salt Movement

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Table ES-11 Summary of Drainage Disposal Options for San Joaquin Valley Export Alternatives (1)						
	Year 2000			Year 2040		
	Areal Application of Option	Problem Water Reduction		Areal Application of Option	Problem Water Reduction	
Disposal Option	Acreage	Acre-Feet	Percent	Acreage	Acre-Feet	Percent
Source Control	84,100	29,400	36.3	159,300	55,800	36.4
Land Retirement	18,000	13,600	16.7	33,000	24,800	16.1
Groundwater mgmt.	15,000	600	7.4	19,000	7,600	5.0
Drainage Reuse	5,900	30,000	36.9	12,100	61,000	39.9
Evaporation System	400	2,200	2.7	1,000	4,000	2.6
Total	123,400	75,800	100.0	224,400	153,200	100.0

(1) Source: SJVDP Final Report, September 1990.

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Table ES-12
Estimated Agricultural Drainage and Treatment Brine Water Quality vs. Ocean Plan Limitations for Toxic Constituents

Constituent	Units	Agricultural Drainage Water[a]	RO Treatment Brine	Ocean Plan (6-month median)[b]
Electrical Conductivity	µS/m	6055	–	NA
Total Dissolved Solids	mg/L	3875	6160	NA
pH	units	7.6	–	NA
Temperature	deg.C	22.5	–	NA
Calcium	mg/L	600	–	NA
Magnesium	mg/L	115	–	NA
Sodium	mg/L	1100	–	NA
Bicarbonate+Carbonate	mg/L	293	–	NA
Postassium	mg/L	3.5	–	NA
Sulfate	mg/L	3450	–	NA
Chloride	mg/L	455	–	NA
Nitrate - N	mg/L	–	42	NA
Arsenic	µg/L	2	–	8
Boron	µg/L	7700	–	NA
Cadmium	µg/L	1	19	1
Chromium	µg/L	13.5	30	2
Copper	µg/L	3	80	3
Iron	µg/L	55	–	NA
Lead	µg/L	3	22	2
Lithium	µg/L	92	–	NA
Manganese	µg/L	260	–	NA
Mercury	µg/L	<0.1	1	0.04
Molybdenum	µg/L	71	–	NA
Selenium	µg/L	11	11	15
Silver	µg/L	–	13	0.7
Vanadium	µg/L	18	–	NA
Zinc	µg/L	20	414	20

[a] (Deverel et al., 1984)
[b] (SWRCB, 1990)
NA = not applicable

Several potential ocean discharge locations were evaluated as part of this Step 1 Feasibility Study. These locations included the existing San Francisco SWOO and other sites to the south that were studied in a 1987 report for the SJVDP. The location of the other sites and boundaries of national marine sanctuaries are shown on Figure ES-11. The existing SWOO is a 12-foot diameter pipeline that discharges 4.5 miles off shore. The design capacity of SWOO is 590 mgd. Currently, flows through the outfall range from 5 to 30 mgd during dry weather and up to approximately 160 mgd during wet weather periods. The minimum initial dilution measured at the SWOO diffusers has been approximately 100:1, which would allow compliance with Ocean Plan standards for either agricultural drainage water or RO brine. The San Francisco outfall does not lie within the Monterey Bay or Gulf of the Farallones National Marine Sanctuary boundaries and national marine sanctuary regulations do not apply. However, it would need to be demonstrated that SWOO discharges would not negatively impact resources within the boundaries of the national marine sanctuaries.

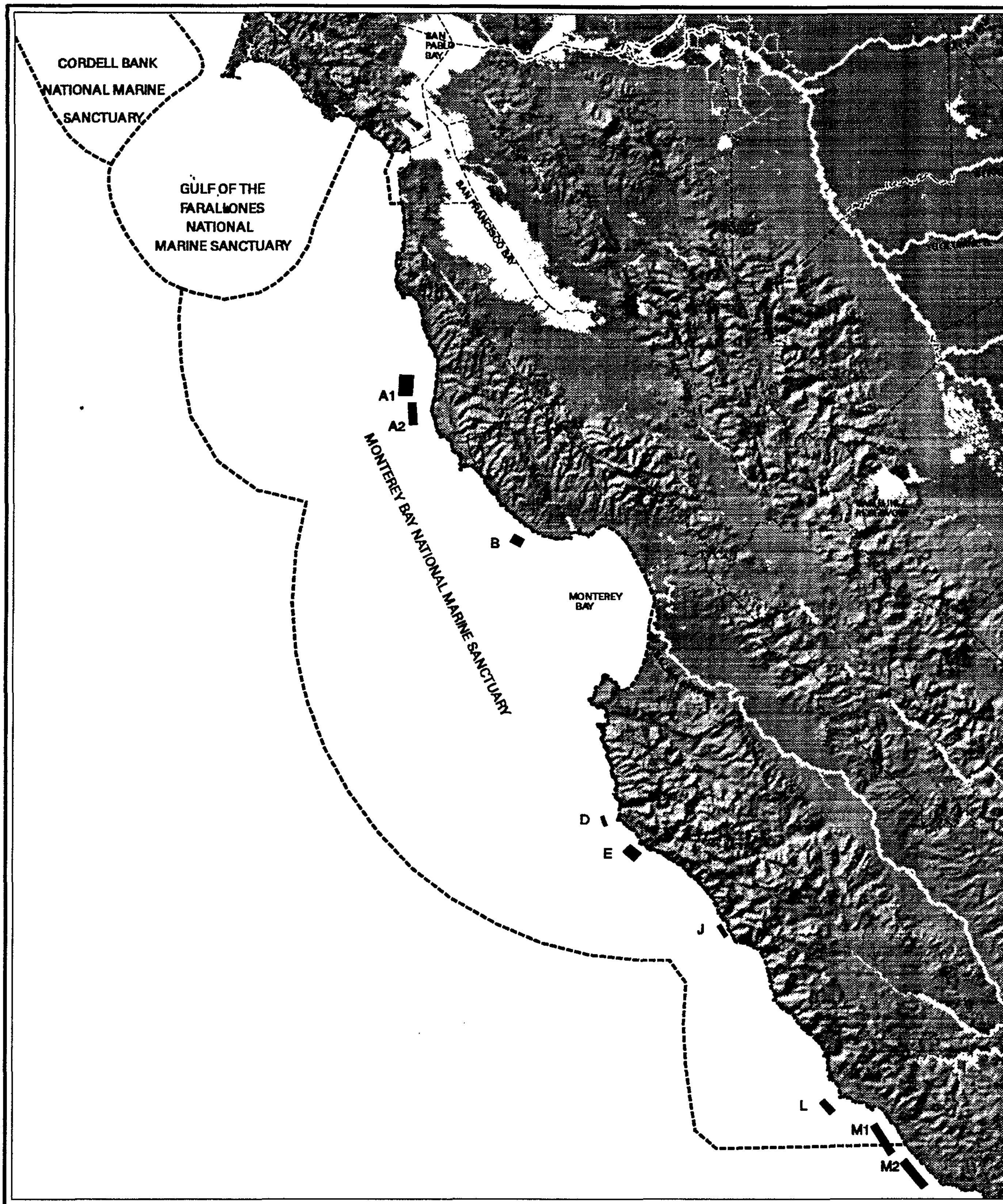
Of the outfall locations considered, the San Francisco outfall and site M2 from the 1987 study appear to be the most feasible because they lie outside the national marine sanctuary boundaries. Another potential outfall site south of Half Moon Bay was considered for some of the subalternatives, however, to establish relative costs. Based on the projected water quality of agricultural drainage water and RO brine, the existing SWOO and any newly designed outfalls of adequate depth should be able to meet Ocean Plan toxicity limitations. Additional far-field dilution and bioaccumulation studies will be required in the Step 2 PEIS in order to assess total impacts of these discharges.

No Project Alternative

As previously discussed, the primary benefits of a regional water recycling program are expected to be improved reliability of water supply and overall improvement of water quality in the Bay/Delta environment. Therefore, to accurately assess the benefits of regional water recycling requires an assessment of the "No Project" alternatives related to water supply and effluent management.

The main water supply concern for San Francisco Bay Area water agencies relates to their system yields during drought conditions. Other regions of California, particularly Central and Southern California have projected shortages even during average water year conditions. A summary of projected water shortages of selected hydrologic regions of California, and the state as a whole, are provided in Table ES-13. As indicated, the projected shortages for the San Francisco Bay Area are significant during drought conditions, even at the present time. These projections are based upon DWR's Bulletin 160-93, the California Water Plan Update. Another recent report published by the Pacific Institute, "California Water 2020: A Sustainable Vision", contends that these projections for shortages are too high. However, the Pacific Institute report assumes that significantly more water recycling will occur by the year 2020 than was assumed by Bulletin 160-93.

DWR's Bulletin 160-93 categorizes water supply options as Level I and Level II. Level I options are measures already being implemented, such as urban water conservation. Level II



Features

- Waterbody
- Brine Desposal Sites
- Marine Sanctuary Boundary
- County Boundaries

FIGURE ES-11
POTENTIAL OUTFALL LOCATIONS

Central California
Regional Water
Recycling Project

Table ES-13
Projected Total Water Shortages for Selected Hydrologic Regions and California (thousands of AF) [a]

Hydrologic Region	1990		2000		2010		2020	
	Average	Drought	Average	Drought	Average	Drought	Average	Drought
San Francisco	0	308	0	341	0	442	30	484
Central Coast	0	70	279	356	305	397	345	450
Sacramento River	0	961	33	898	33	871	33	829
San Joaquin River	0	324	155	453	70	303	40	274
Tulare Lake	0	512	720	1,233	715	1,227	585	1,097
State of California [b]	0	2,700	3,000	6,000	3,200	6,400	3,700	7,000
State of California [c]	0	2,700	5,000	8,000	5,200	8,400	5,700	9,000

[a] Based upon D-1485 for required Delta flows.
[b] Equivalent to projected net demand minus projected supply. Assumes a proposed additional environmental water demand of 1 MAF.
[c] Equivalent to projected net demand minus projected supply. Assumes a proposed additional environmental water demand of 3 MAF.
Source: California Water Plan Update, Bulletin 160-93. Sacramento, California: California Department of Water Resources. Volume I, Table 6-11, 7-17, 8-6, S-1, SF-3, CC-3, SR-3, SJ-3, and TL-3. October 1994.

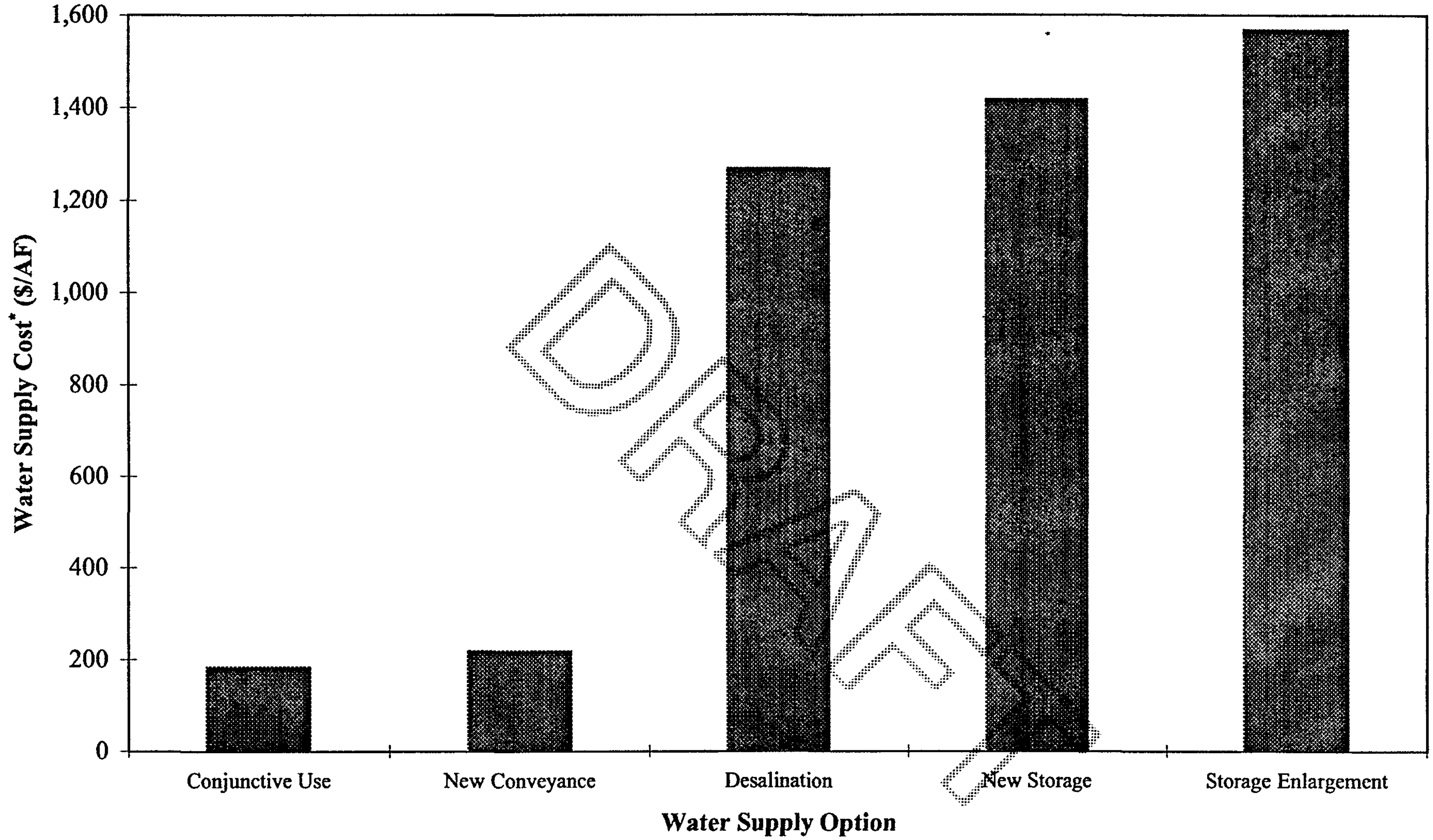
options are additional measures that are needed to meet long-term water demands, but require more extensive investigation. Some of the Level II options identified in Bulletin 160-93 are shown on Figure ES-12. The costs shown for these options are considered to be maximum costs at this point. These costs are considered preliminary, however, and additional work is needed to verify the assumptions for these costs compared to the assumptions used in this study. The conjunctive use option involves storage of surface water supplies in groundwater basins for later use. New conveyance facilities could be constructed through the Delta to increase the yield of the SWP and/or the CVP. Desalination of seawater, new storage facilities, and enlargement of existing storage reservoirs would all likely be more expensive options. The drought yields of each of the less expensive Level II options would be a maximum of 200 TAF for conjunctive use and 400 TAF for new conveyance facilities. Assuming the projections of Bulletin 160-93, or even the lower projections shown in the Pacific Institute Report, there will continue to be a need for projects such as the CCRWRP that look at maximizing the potential yield from water recycling.

Implementation of the local recycling projects identified in this study would significantly reduce the mass loading of pollutants to San Francisco Bay from municipal wastewater dischargers. The ambient water quality levels of many toxic constituents would not likely be reduced significantly in the Bay, however, since their sources are typically from runoff, agricultural drainage, or mine drainage. This fact means that without an overall watershed approach to toxics control in the Bay/Delta environment, there will continue to be little or no dilution capacity in the Bay for many toxic constituents. It is likely, therefore, that there will be continued pressures placed on municipal dischargers in the future to lower the concentrations of some constituents. The control of toxic pollutants is now focused on several metals (such as copper and nickel). In the future, the emphasis is expected to shift to bioaccumulative pollutants such as mercury, selenium, polynuclear aromatic hydrocarbons, and other organic compounds.

To determine whether the export of recycled water (and essentially zero discharge) is economically viable requires that the cost of continued discharge to the Bay be estimated. The following No Project alternatives were developed to provide a range of options that would reduce the concentration of toxic pollutants discharged and reduce mass loadings to the Bay:

- No Project Alternative NP-A: Source Reduction
- No Project Alternative NP-B: Southwest Ocean Outfall Disposal
- No Project Alternative NP-C: New Ocean Outfall Disposal
- No Project Alternative NP-D: Reverse Osmosis Treatment

Just as continued implementation of urban water conservation measures has been assumed in future water supply projections, continued implementation of source reduction and pollution prevention measures are assumed to be a "given" for municipal wastewater dischargers. In fact, the values previously presented for water quality of recycled water (Table ES-4) have incorporated expected toxic reductions related to source reduction activities. If comprehensive watershed management is not implemented, however, it is likely that one of the additional



*Based on drought yield.

FIGURE ES-12
Estimated Costs of Level II Water Supply Options

measures identified above will eventually be needed to comply with water quality objectives for the Bay.

The concept of No Project Alternative NP-B was developed after the evaluation of salt management options showed that Ocean Plan water quality requirements could be met for the SWOO discharge of either agricultural drainage water or brine generated by RO treatment of Bay Area wastewater. The concentration of toxic constituents in Bay Area wastewater would be much less than the concentrations predicted for RO brine, and therefore, treated wastewater discharged through the SWOO would also be expected to comply with Ocean Plan requirements. The layout of connecting pipelines that would be required for this No Project alternative are presented on Figure ES-13. The No Project Alternative NP-C would involve the construction of a new outfall at an alternative site south of Half Moon Bay. The No Project Altèrnative NP-D would involve the upgrading of Bay Area wastewater treatment plants beyond tertiary levels with RO treatment. The purpose for RO treatment in this case would be for the reduction of toxics, not necessarily TDS, as opposed to the use of RO in salt management. As with salt management, the assumption made for brine disposal for this No Project alternative was the construction of a brine collection system that discharged into the ocean through San Francisco's SWOO.

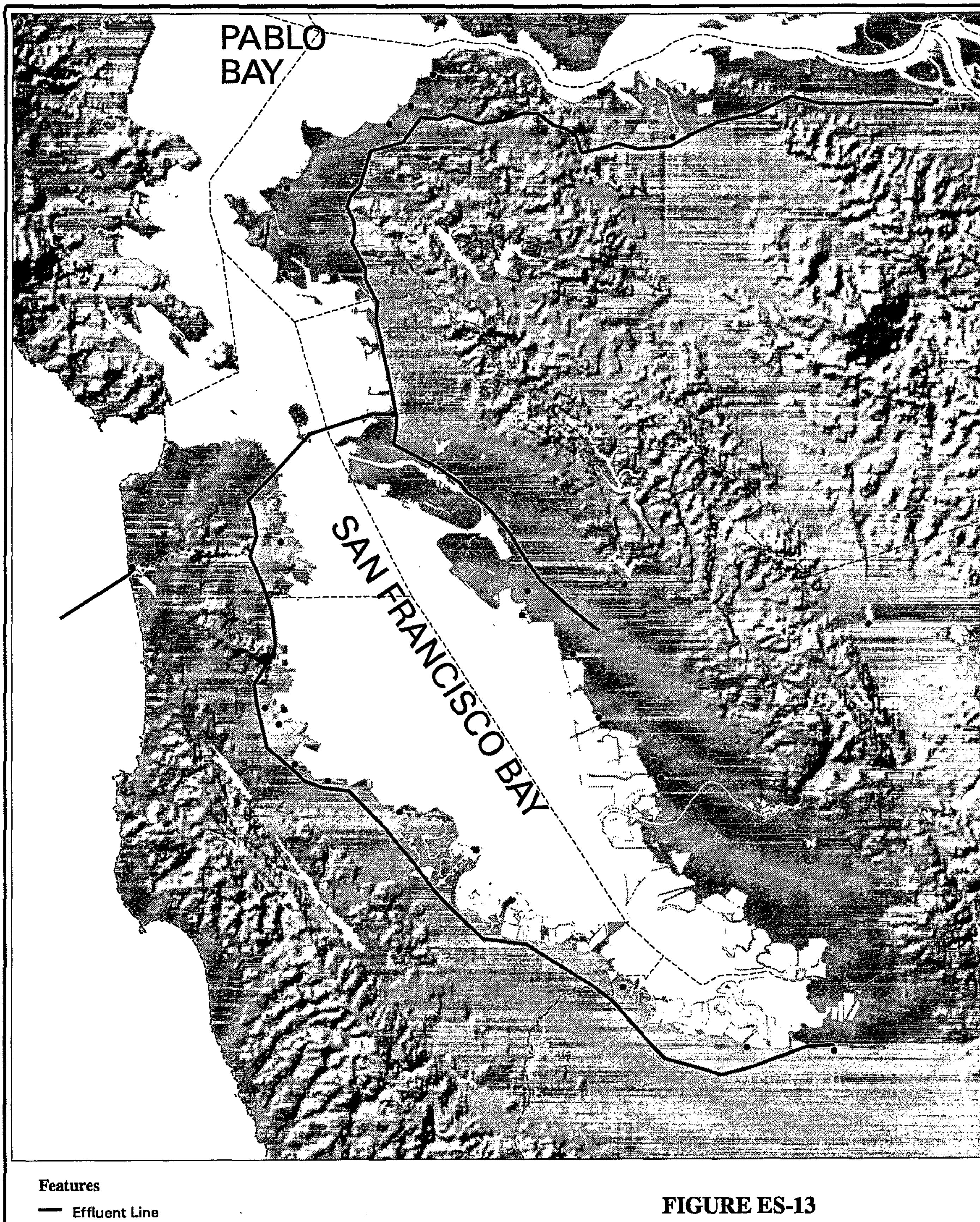
The relative costs and projected percentage of metals loading removed by each of the No Project alternatives is shown on Figure ES-14. Based upon this analysis, No Project Alternative NP-B, disposal of all Bay Area effluent through the SWOO, is recommended as the standard by which export recycling projects should be measured for handling effluent in the future.

Description of Export Alternatives

As previously discussed, the five CCRWRP alternatives are each a combination of local recycling and export alternatives. The local recycling component is the same for all five export alternatives. To accommodate various options related to treatment level, place of use, storage, and salt management, the five export alternatives were developed into a total of 30 subalternatives. A composite listing of the 30 subalternatives is presented in Table ES-14. Brief descriptions of these subalternatives are provided below.

Export to Delta Mendota Canal

As shown in Table ES-14, six of the DMC subalternatives assume tertiary treatment levels and two assume RO treatment levels. Where RO is provided the TDS would be reduced to approximately 50 mg/l and there would not be a need for further mitigation of salt impacts. The RO treatment would occur at a regional advanced treatment facility located in Dublin, and brine would be pumped back to the SWOO for disposal. All of the DMC alternatives would discharge below Tracy to avoid the need to find an alternative potable water supply for the City of Tracy. Two of the DMC alternatives would discharge below the O'Neill Pumping Plant to avoid the connection to the SWP and two would discharge at the Hospital Creek storage site, located between Tracy and O'Neill. Three of the DMC options assume no storage



Features

- Effluent Line
- Tunnel
- Brine Line
- Treatment Plant

0 2 4 6 8 10
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FIGURE ES-13
ALTERNATIVE NP-B

Central California Regional Water Recycling Project

/gis4/ccrwrp/figs_1/ALTNP.AML - July 10, 1995

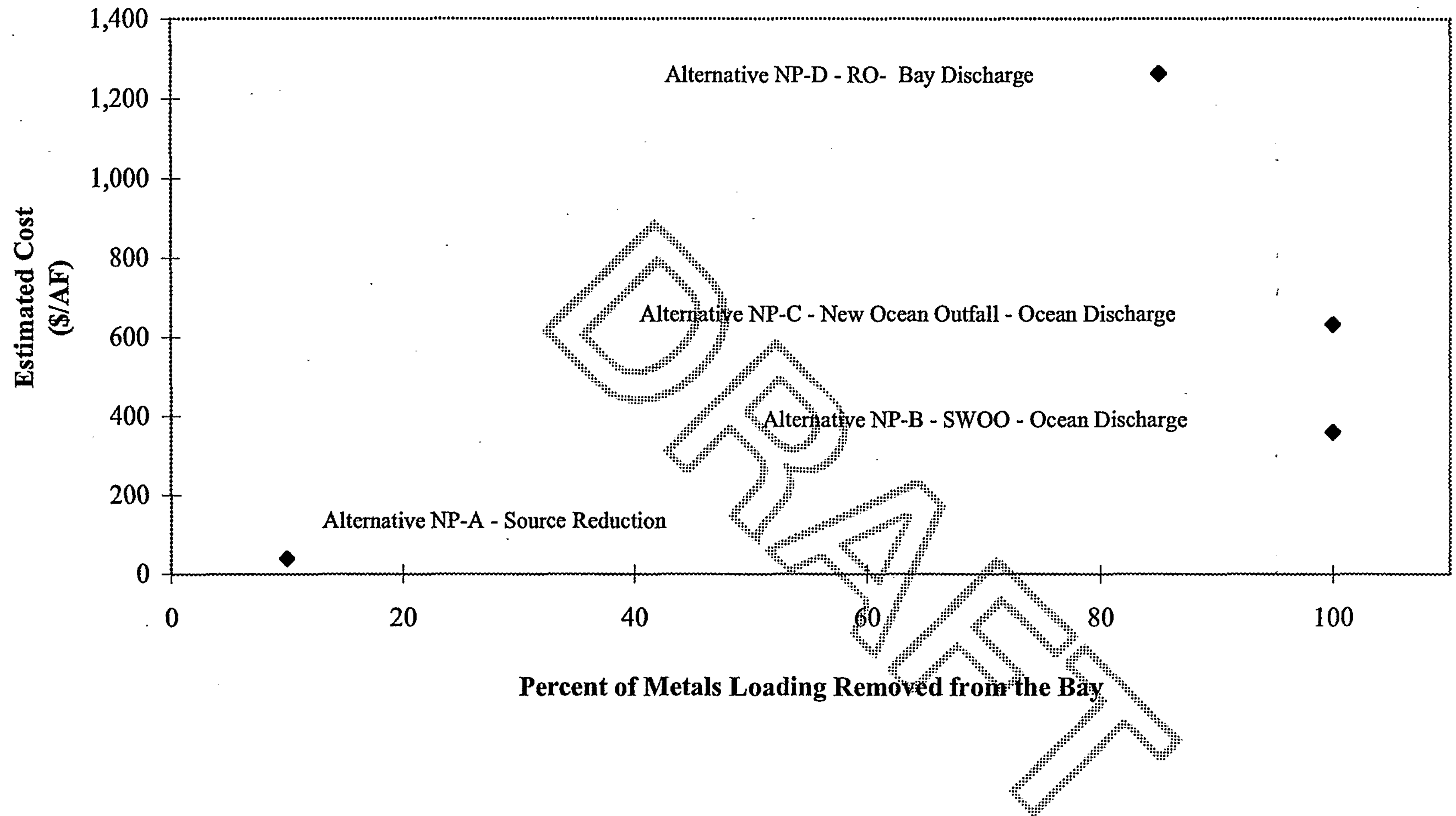

Figure ES-14
No Project Effluent
Management Alternatives
Cost Comparison

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Table ES-14
Definition of Export Alternatives

Alternative	Treatment Level	Place of Use	Storage Location	Storage Volume (TAF)	Salt/Brine Management
DMC					
1A	Tertiary	Below Tracy	None	0	Mitigation: SWOO
1B	Tertiary	Below Tracy	None	0	Mitigation: New Outfall
1C	Tertiary	Below Tracy	Kellogg	135	Mitigation: SWOO
1D	Tertiary	Hospital Creek	Hospital Creek	432	Mitigation: SWOO
1E	Tertiary	Below O'Neill	Hospital Creek	432	Mitigtion: SWOO
1F	Tertiary	Below O'Neill	Hospital Creek	432	Mitigation: In-Valley
1G	RO	Below Tracy	None	0	Prevention: Brine to SWOO
1H	RO	Hospital Creek	Hospital Creek	432	Prevention: Brine to SWOO
Delta Area					
2A	Tertiary	Chipps Island	None	0	N/A
2B	Tertiary	Chipps Island	Webb Tract	119	N/A
2C	Tertiary	Chipps Island	Webb Tract, Bacon Is.	238	N/A
2D	Secondary	Chipps Island	None	0	N/A
2E	RO	Chipps Island	Webb Tract, Bacon Is.	238	Brine to SWOO
2F	RO	Chipps Island	Webb Tract, Bacon Is.	238	Brine Evaporation/Landfill
2G	RO	Delta Islands	Webb Tract	119	Brine to SWOO
Monterey Bay Area					
3A	Tertiary	Monterey Bay Area	None	0	N/A
3B	Tertiary	Monterey Bay Area	Pacheco B	400	N/A
3C	RO	Monterey Bay Area	None	0	Brine to SWOO
3D	RO	Monterey Bay Area	Pacheco B	400	Brine to SWOO
3E	RO	Monterey Bay Area	Pacheco B	400	Brine to SWOO
3F	RO	Monterey Bay Area	Salinas Valley Aquifer	3500	Brine to SWOO
3G	Tertiary	Monterey Bay Area/ Chipps Island	Pacheco B	400	N/A
Southern San Joaquin Valley					
4A	Tertiary	Westlands	None	0	Mitigation: New Outfall
4B	Tertiary	Westlands	Panoche	316	Mitigation: New Outfall
4C	Tertiary	Westlands	Panoche	316	Mitigation: SWOO
4D	Tertiary	Westlands	None	0	Mitigation: New Outfall
4E	RO	Westlands	Panoche	316	Prevention: Brine to SWOO
Indirect Potable Reuse					
5A	RO	Bay Area	Existing Reservoirs	222	Brine to SWOO
5B	RO	State Water Project	Los Banos Grande	385	Brine to SWOO
5C	RO	Bay Area/SWP	Existing Reservoirs/ Los Banos Grande	382	Brine to SWOO

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would be provided, four assume the Hospital Creek site would be utilized, and one assumes the Kellogg storage site. For those alternatives not providing RO treatment, there was an assumption made that mitigation of salts imported into the Valley would be necessary. One of the alternatives utilized in-Valley salt management, one utilizes a new outfall constructed south of Half Moon Bay, and the remainder of the alternatives develop costs assuming agricultural drainage water is piped back to the SWOO for disposal.

Export to the Delta Area

Six of the Delta Area alternatives would utilize recycled water (in place of upstream reservoir releases) for salinity repulsion at Chipps Island. Alternative 2G would utilize recycled water for irrigation in the Delta Islands. Tertiary treatment was assumed for three of the Delta alternatives, RO treatment for three, and secondary treatment for one. RO treatment was assumed to be necessary for irrigation uses in order to overcome Delta Protection Commission guidelines that ban the importation of recycled water. Where storage is provided, Webb Tract and Bacon Island are assumed as the sites for surface reservoirs. Where RO treatment is provided, brine disposal would occur through the SWOO for two of the alternatives and by evaporation and landfilling for one of the alternatives.

Export to the Monterey Bay Area

The Monterey Bay Area alternatives assume RO treatment for four of the options and tertiary treatment for three of the options. One of the options, Alternative 3G, represents a combintation of Delta Area and Monterey Bay Area places of use. Where storage is provided, Pacheco B, in southern Santa Clara County, is the assumed reservoir location for all but one alternative. Alternative 3F assumes the Salinas Valley Aquifer is utilized for storage. Where RO treatment is assumed, brine disposal is assumed to occur through the SWOO.

Export to the Southern San Joaquin Valley

As indicated in Table ES-14, the export to Southern San Joaquin Valley assumes tertiary treatment for all options except Alternative 4E which assumes RO treatment for salt prevention. The place of use for all of the Alternative 4 options is assumed to be the Westlands Water District since their demand for water is so high. In all cases, a new transmission pipeline would be constructed to Westlands through southern Santa Clara County and San Benito County. Where storage is provided, the Upper Panoche Creek site is assumed. The mitigation of imported salts is handled by ocean disposal of agricultural drainage water through the SWOO or through a new outfall located south of the Monterey Bay National Marine Sanctuary.

Indirect Potable Reuse

As previously discussed, the use of recycled water for indirect potable reuse would require advanced treatment utilizing RO and other processes and a storage program that ensures one year detention time prior to consumption. All three Indirect Potable Reuse options, therefore, include RO treatment, and all three assume brine disposal through the SWOO.

Alternative 5A assumes that existing Bay Area reservoirs would be utilized for blending and storage of "repurified" water. Alternative 5B assumes that the new Los Banos Grande Reservoir would be utilized for blending and storage, and that the "repurified" water would become part of the SWP supply. Alternative 5C represents a combination of the 5A and 5B approaches to storage and use of the "repurified" supply.

Evaluation of Export Alternatives

The technical assessment of export alternatives has been summarized in the preceeding subsections of this Executive Summary. The following approach was taken in the economic evaluation of export alternatives:

A. The total yields and yields potentially available for exchange with Bay Area water agencies were evaluated for average conditions and drought conditions.

B. The capital costs and annual operation and maintenance (O&M) costs were converted to a total annual cost for each alternative.

C. The effluent management costs for ocean discharge through the SWOO (No Project Alternative NP-B) were multiplied by the percent of recycled water removed from Bay discharge for each alternative.

D. A net annual water supply cost was calculated by subtracting the avoided effluent management costs (C) from the total annual costs (B).

E. The unit water supply costs were calculated by dividing the net annual water supply cost (B-C) by the total yields expected for drought conditions (A).

F. The unit water supply costs ($\frac{B-C}{A}$) were compared for all alternatives to come up with the recommendations regarding which alternatives should be considered economically feasible.

Examples of the model runs utilized to evaluate yields are provided by Figures ES-15 and ES-16. Figure ES-15 displays theoretical supplies versus demands for the DMC based upon 70 years of water year data and recently adopted salinity requirements for the Delta. The ability of recycled water to make up for water shortages in the DMC is shown by the dashed line for Alternatives 1E and 1F. Figure ES-16 indicates how recycled water could be utilized to replace various percentages of reservoir releases required for salinity repulsion, depending on the Delta subalternative assumed. Similar model runs were conducted for average year and wet year conditions to fully assess expected yields over time.

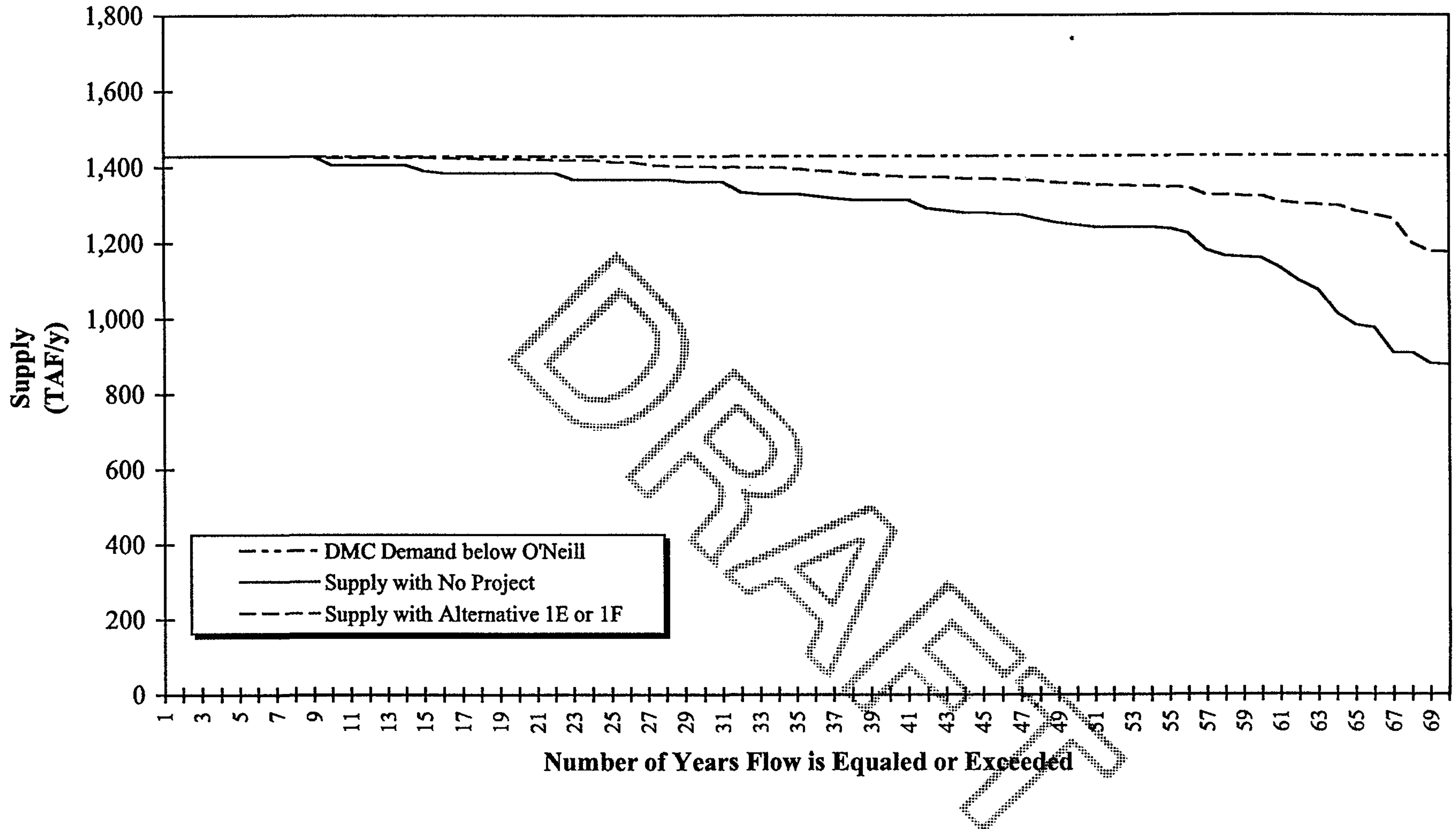

FIGURE ES-15
DMC Supply Available with Recycled Water Delivered below O'Neill (Exchange Priority)

Note: This figure is based upon the second DMC modeling method that accounts for transfers and then shortages.

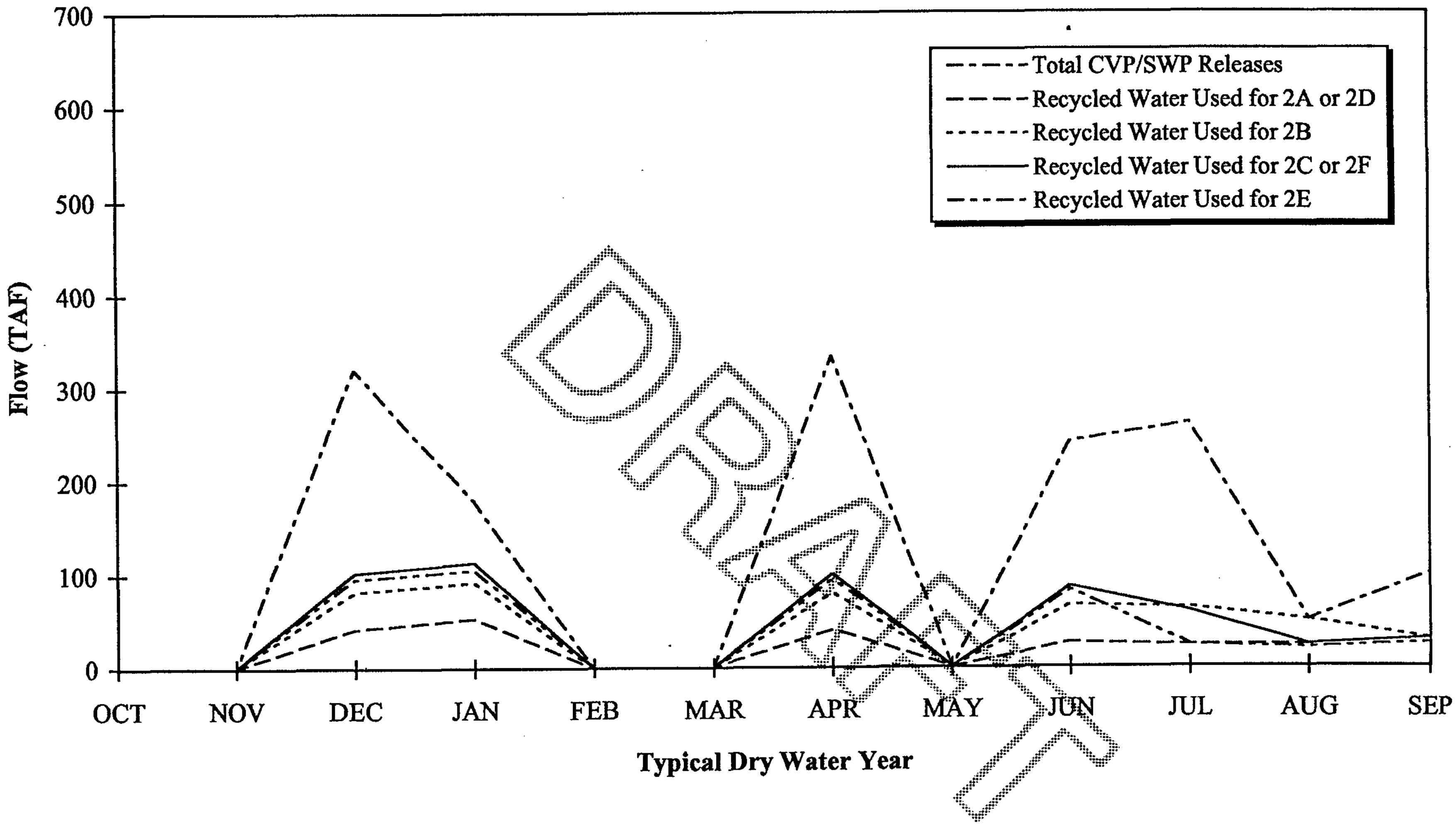

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FIGURE ES-16
CVP/SWP Releases and Recycled Water Used in Typical Dry Water Years

An example of how the net water supply cost was calculated is provided in Table ES-15. Again, the water supply component was obtained by subtracting an avoided effluent management cost from the total project cost. The maximum avoided effluent management cost (approximately $350 per acre foot) has been subtracted from the DMC and Monterey Bay alternatives. No avoided effluent management cost has been subtracted from the total project cost for the Delta salinity repulsion alternative since discharge into the Delta will end up back in the Bay. Due to this fact, the feasibility of discharging to the Delta may be linked to implementation of a comprehensive watershed management approach to the control of toxic constituents in the Bay/Delta environment.

Key assumptions utilized in preparing cost estimates for the Administrative Draft Report include the following criteria:

- Capital costs include a 35 percent contingency cost added to all estimates.
- O&M costs assume a power cost of $0.06 per kilowatt hour.
- Financing costs assume bonds are issued with an 8 percent interest rate and 25 year financing period.

As a result of the economic evaluation, the following export alternatives were recommended for further evaluation:

- Alternative 1E, Agricultural Irrigation and Wildlife Refuge Supply in DMC Service Area, Tertiary Treatment with Storage at Hospital Creek, Agricultural Drainage Disposal through the SWOO.
- Alternative 2C, Salinity Repulsion in the Delta, Tertiary Treatment with Storage at Webb Tract and Bacon Islands.
- Alternative 3B, Agricultural Irrigation in Monterey Bay Area, Tertiary Treatment with Storage at Pacheco B.
- Alternative 3G, Salinity Repulsion in the Delta and Agricultural Irrigation in Monterey Bay Area, Tertiary Treatment with Storage at Pacheco B.
- Alternative 4B, Agricultural Irrigation in Southern San Joaquin Valley, Tertiary Treatment with Storage at Upper Panoche Creek, Agricultural Drainage Disposal through a New Outfall South of the Monterey Bay National Marine Sanctuary.
- Alternative 5A, Indirect Potable Reuse in Bay Area, Storage and Blending at Local Reservoirs, Brine Disposal through the SWOO.

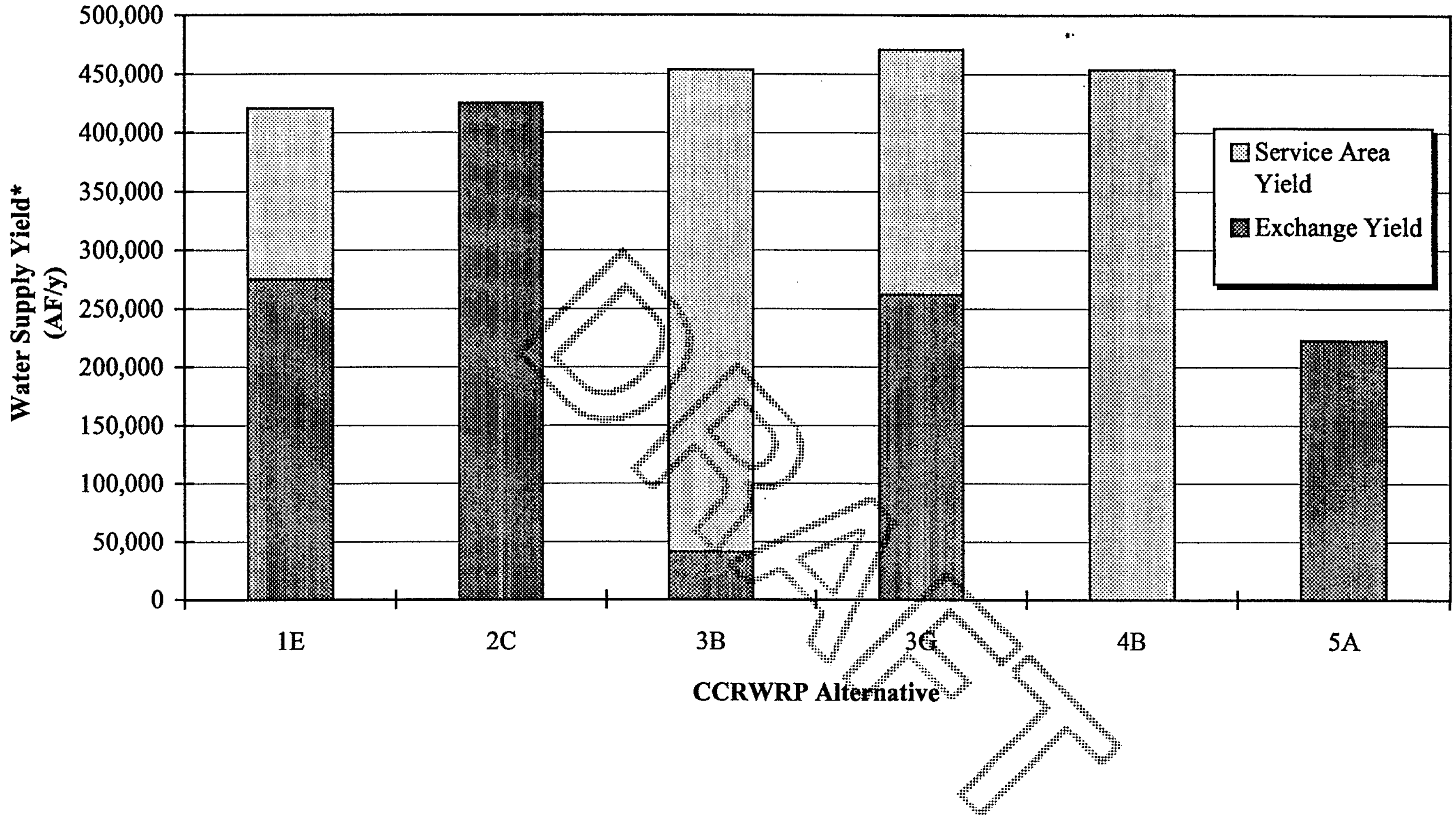
Projected water supply yields for each of these alternatives are provided on Figure ES-17. Water supply unit costs are presented on Figure ES-18.

Table ES-15

Recycled Water Export Alternative Water Supply Costs

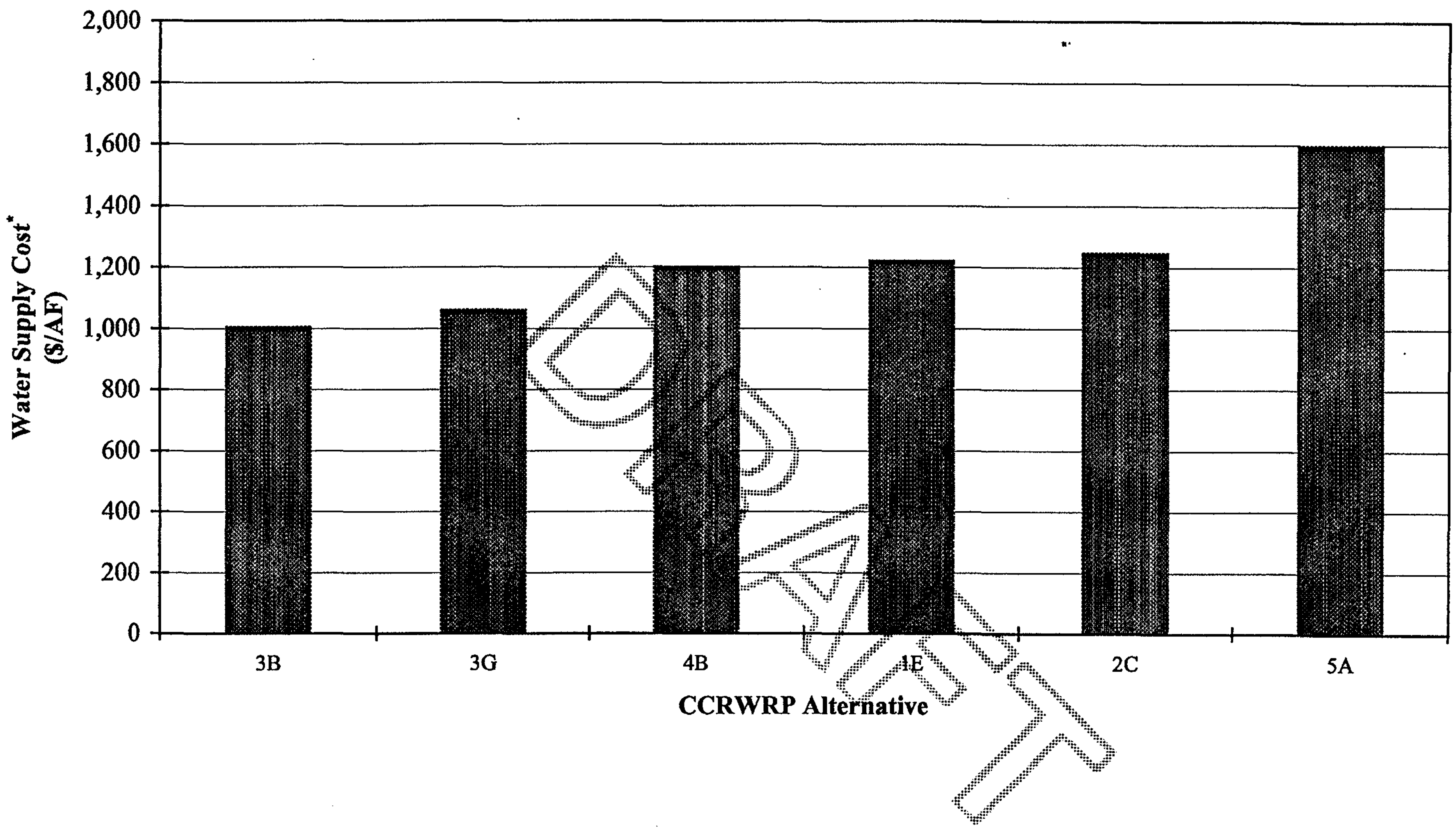
Alternatives	Annual Cost ($million/y)		
	Total Project	**Effluent Management Component***	**Water Supply Component**
Delta Mendota Canal			
1E O'Neill/Tertiary/Hospital Creek/SWOO	628.8	113.8	515.0
Delta Service Area			
2C Tertiary/High Storage	531.8	0.0	531.8
Monterey Bay Area			
3B Tertiary/Storage	618.9	162.3	456.6
3G Combination of 2A and 3	590.0	89.5	500.5
South San Joaquin Area			
4B Tertiary/Storage/Partial Dist/New Outfall Drain	707.8	162.3	545.5
Indirect Potable Reuse			
5A RO/Existing Local Reservoirs	436.0	79.6	356.4

*Effluent management costs include cost for ocean disposal at SWOO (Alternative NP-B) multiplied by the percent of recycled water removed from Bay discharge.



* Based on drought yield.

FIGURE ES-17
Exchange and
Service Area Yield



*Based on drought yield.

FIGURE ES-18
Water Supply Costs
of Export Alternatives

The next step taken in the evaluation of export alternatives was an assessment of each of the six alternatives compared to the feasibility criteria estabished by the participating agencies. This assessment is summarized in Table ES-16. Each of the six alternatives is compared to the listed criteria for technical, economic, environmental, public acceptance, and political/institutional feasibility. As shown by Table ES-16, four subalternatives (1E, 2C, 3B, and 3G) achieve total scores greater than 35 (approximately 70 percent) for the listed criteria.

Conclusions and Recommendations

The results of this Step 1 Feasibility Study show that approaching water recycling on a regional basis can achieve significant water supply and effluent management benefits at costs that are competitive with other future new water supplies. Specific conclusions and recommendations are provided below.

Conclusions

The four export alternatives receiving the highest ranking in Table ES-16 should be considered potentially feasible based upon work conducted in the Step 1 Study. Thus, the regional projects identified as potentially feasible are the following:

- Local Recycling and Export to the Delta Mendota Canal (Alternative 1E)
- Local Recycling and Export to the Delta Area (Alternative 2C)
- Local Recycling and Export to the Monterey Bay Area (Alternative 3B)
- Local Recycling and Export to the Monterey Bay Area and Delta Area (Alternative 3G)

Layouts of the export component of the first three alternatives are provided on Figures ES-19, ES-20, and ES-21. Alternative 3G (a combination of Alternatives 2C and 3B) is shown schematically on Figure ES-22.

The summary of yields and unit water supply costs for each of the four regional alternatives was shown in Table ES-1 of this Executive Summary. The unit water supply costs range from about $1,000 to $1,200 per acre foot. These costs compare favorably to other future new sources of water (such as desalination, new reservoirs, etc.). The total yields of these alternatives are significant. Including the 205,000 AF/y projected yield for local recycling, the total annual yields for these alternatives will be in the 600,000 to 700,000 acre foot range. The total potential yields for exchange (potential water transfers back to the Bay Area) range from about 250,000 acre feet for the Monterey Bay Area alternative to about 650,000 acre feet for the Delta Area alternative.

Table ES-16
Recycled Water Export Alternative Evaluation Matrix

Feasibility Criteria	DMC 1E	Delta 2C	Monterey 3B	Monterey 3G	South San Joaquin 4C	Indirect Potable Reuse 5A
	Application of Criteria to Alternatives*					
Technical						
Meets water quality requirements for proposed uses	3	2	2	2	2	2
No net increase of salts in basins	2	2	2	2	2	3
Protects existing potable water supplies	2	2	2	2	2	1
Reuses significant amount of water locally	2	2	2	2	2	2
Economic						
Net cost of water is less than cost of developing other new water sources	3	3	3	3	2	1
Costs can be fairly allocated	2	2	2	2	2	2
Long-term economic advantage can be demonstrated	2	2	2	2	1	1
Environmental						
Provides positive net gain for the environment	2	2	2	2	2	2
Maintains or enhances public health	2	2	2	2	2	1
Improves conditions in the Bay/Delta	3	3	3	3	3	1
Public Acceptance						
Satisfies health and safety perceptions for municipal and industrial use	2	2	2	2	2	1
Satisfies health and safety perceptions for agricultural use	2	2	1	1	2	3
Can win general public acceptance	2	2	3	2	1	1
Political/Institutional						
Possibility of developing a politically acceptable funding mechanism	2	2	1	2	1	2
Offers integrated, multiple-purpose solutions	2	2	2	3	2	1
Is compatible with other water supply and water recycling efforts	2	2	3	3	2	2
Can be coordinated with relevant governmental agencies (federal, state, regional, and local)	2	2	2	2	2	1
Sum of Scores	37	36	36	37	32	27

*Scoring: 1 Below Average for Recycled Water Alternatives
2 Average for Recycled Water Alternatives
3 Above Average for Recycled Water Alternatives

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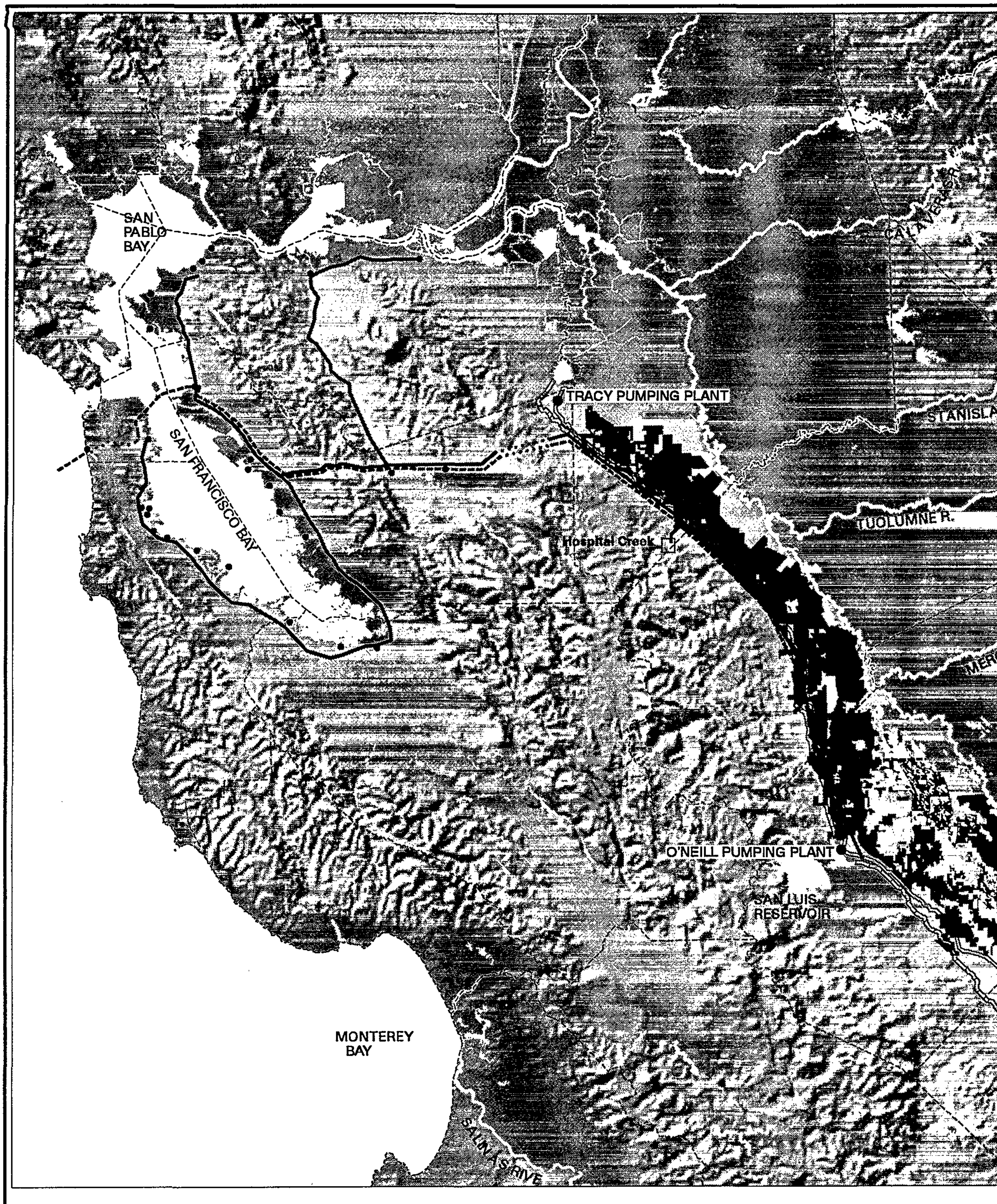

Features

- Recycled Water Line
- Drainwater Line
- State Water Project
- Delta-Mendota Canal
- Tunnel
- Treatment Plant
- New Reservoir

0 2 4 6 8 10
MILES

FIGURE ES-19
ALTERNATIVE 1E

Central California Regional Water Recycling Project

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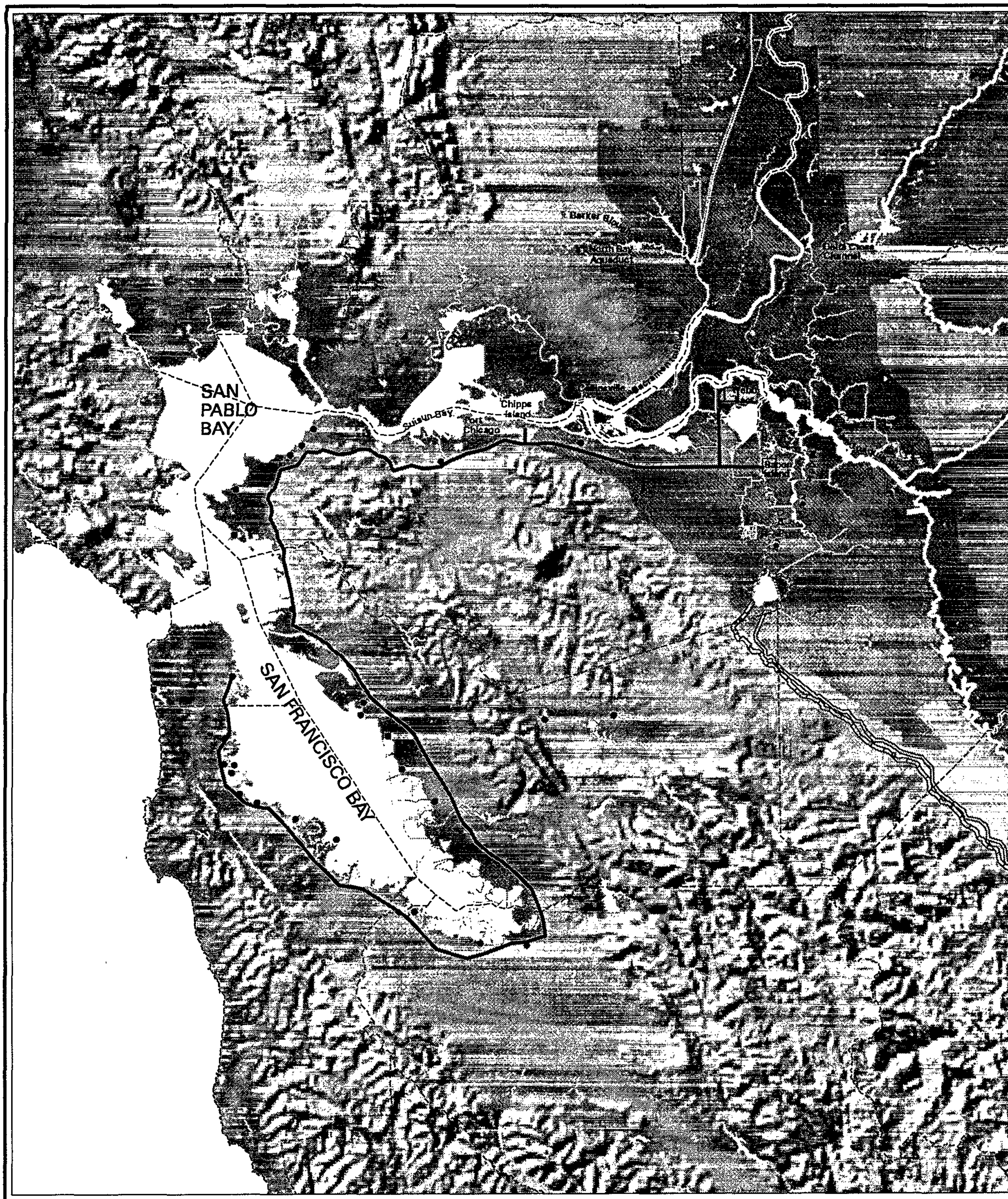

Features

- Recycled Water Line
- Brine Line
- State Water Project
- Delta-Mendota Canal
- Tunnel
- Treatment Plant
- Advanced Treatment
- New Reservoir

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FIGURE ES-20
ALTERNATIVE 2C

Central California Regional Water Recycling Project

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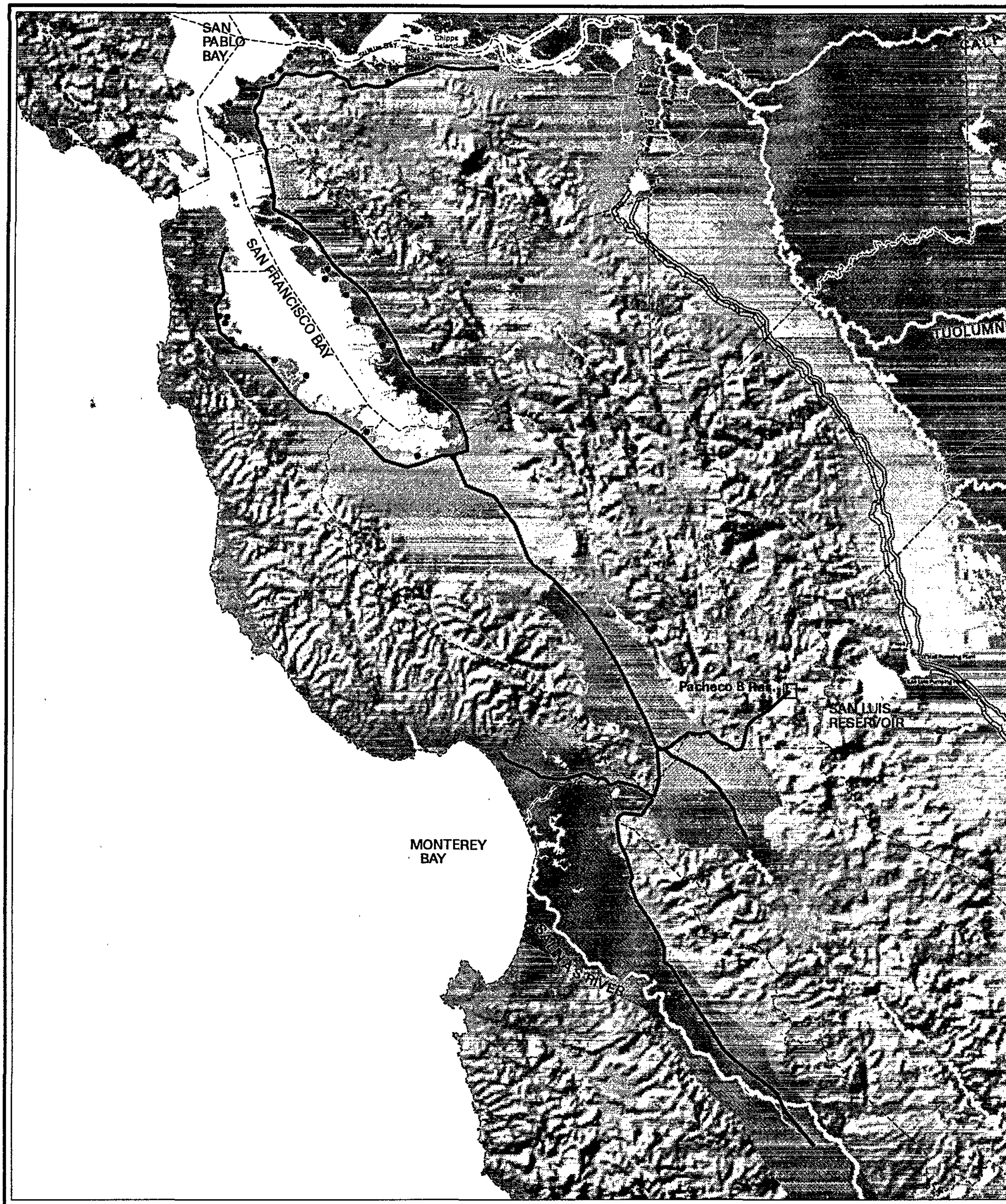

Features

- Recycled Water Line
- State Water Project
- Delta-Mendota Canal
- Treatment Plant
- New Reservoir

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FIGURE ES-21
ALTERNATIVE 3B

Central California
Regional Water
Recycling Project

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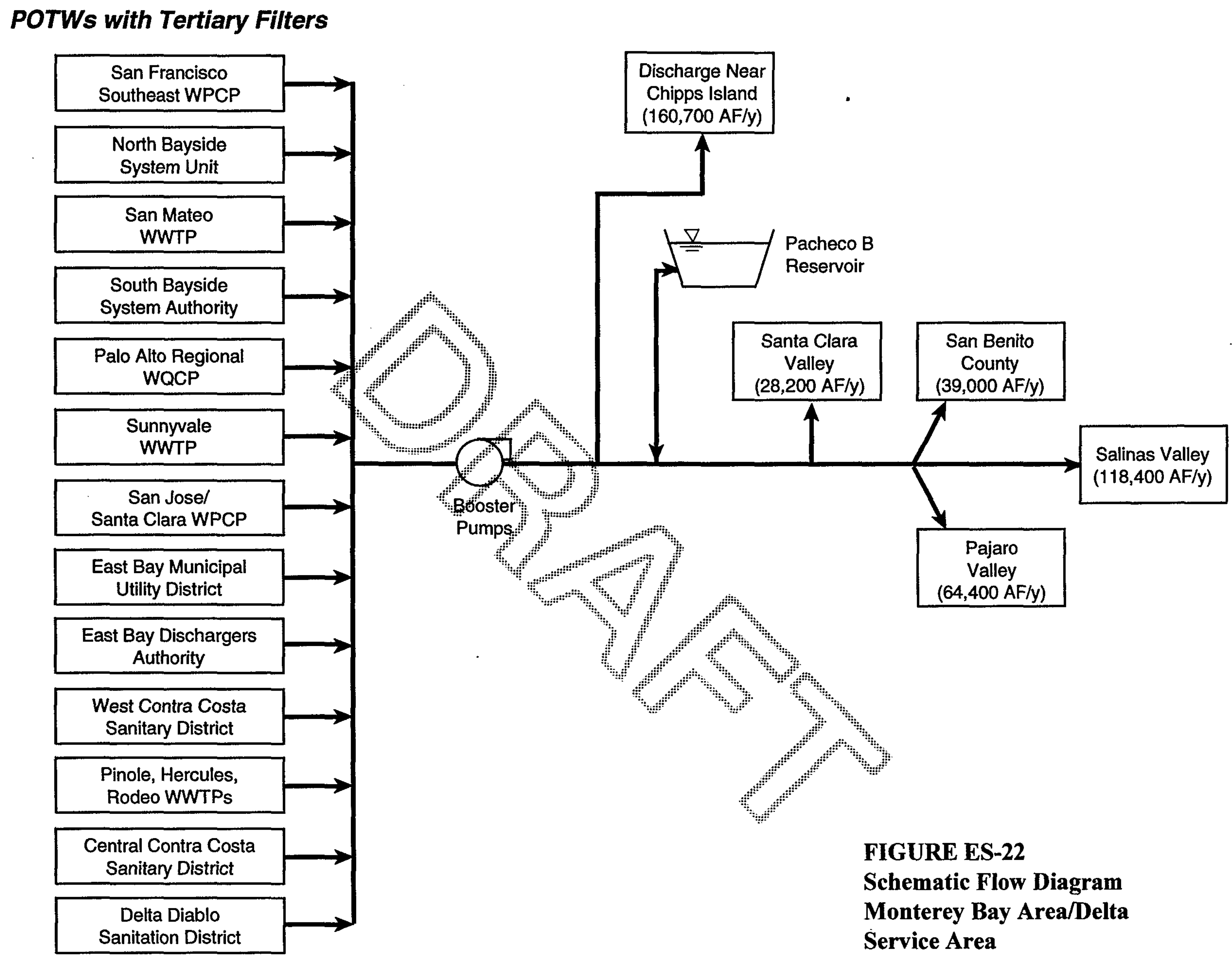

FIGURE ES-22
Schematic Flow Diagram
Monterey Bay Area/Delta
Service Area
Alternative 3G

Table ES-17 Summary of Place of Use Assumptions for Potentially Feasible Alternatives		
Alternative	**Water Quality Issue**	**Assumption for Mitigation**
1E	• DMC serves potable water to some municipalities.	• Deliver recycled water to DMC south of O'Neill. Utilize State aqueduct as an alternative supply to other affected agencies.
	• DMC delivers potable water to San Luis Reservoir from September to February.	• Deliver recycled water to DMC below O'Neill Forebay so that no flow gets to O'Neill Pump Station.
	• DMC delivers water to agricultural uses.	• Treat recycled water to Title 22 standards. Reduce TDS concentrations by source reduction and blending. Transport mass of salts equivalent to that imported back to the ocean.
	• DMC delivers water to wildlife refuges, Mendota Pool and(indirectly) to San Joaquin River.	• Reduce concentration of toxic constituents to acceptable levels by pollution prevention at source and by blending with Delta water. • Implement upstream watershed management program to reduce ambient concentrations of toxics in Delta water.
2C, 3G	• Delta water quality objectives will be at least as stringent as objectives for the San Joaquin River and San Francisco Bay.	• Treat recycled water to Title 22 standards. Reduce concentrations of toxic constituents to acceptable levels by pollution prevention at source and by dilution with Delta water. • Implement upstream watershed management program to reduce ambient concentrations of toxics in Delta water.
3B, 3G	• Recycled water delivered to agricultural uses in Monterey Bay Area.	• Treat recycled water to Title 22 standards. Reduce TDS concentrations by source reduction.

A summary of place of use considerations for the four potentially feasible alternatives is provided in Table ES-17. Compliance with Title 22 requirements for all nonpotable uses can be achieved with tertiary treatment. Compliance with salt requirements can generally be achieved by source reduction of salts in wastewater collection systems. For the DMC alternative, additional salt management measures will involve blending with Delta water prior to use and transport of a mass of salts equivalent to that imported back to the San Francisco ocean outfall (SWOO).

Water quality objectives can typically be met in all cases with respect to recycled water use and disposal of agricultural drainage water. Implementation of watershed management principles will be critical to long-term water quality compliance in the Delta, with or without the introduction of recycled water for salinity repulsion.

All four potentially feasible alternatives incude the use of surface reservoirs for storage during winter months. Siting studies for these and other facilities will be needed in the Step 2 PEIS.

Recommendations

Work on the Step 2 PEIS should proceed for the alternatives identified as potentially feasible. The following studies should be conducted in parallel with preparation of the PEIS:

- Funding and Rate Study to Demonstrate Impact of Project to Local Agencies.
- Siting and Routing Study to Evaluate Specific Location of Required Facilities.
- Salt Reduction Study to Determine the Cost Effective Removal of Salts at Their Sources.
- Operational Study to Determine How Each System Would Operate.
- Water Quality Studies at Each Place of Use to Assess Specific Impacts to Soils, Surface Water, Groundwater, and Biota.
- Water Transfer Study to Address the Legal Hurdles to Implementing Transfers.

Implementation of the CCRWRP should proceed in a phased approach. Possible phasing schedules are presented on Figures ES-23 and ES-24.

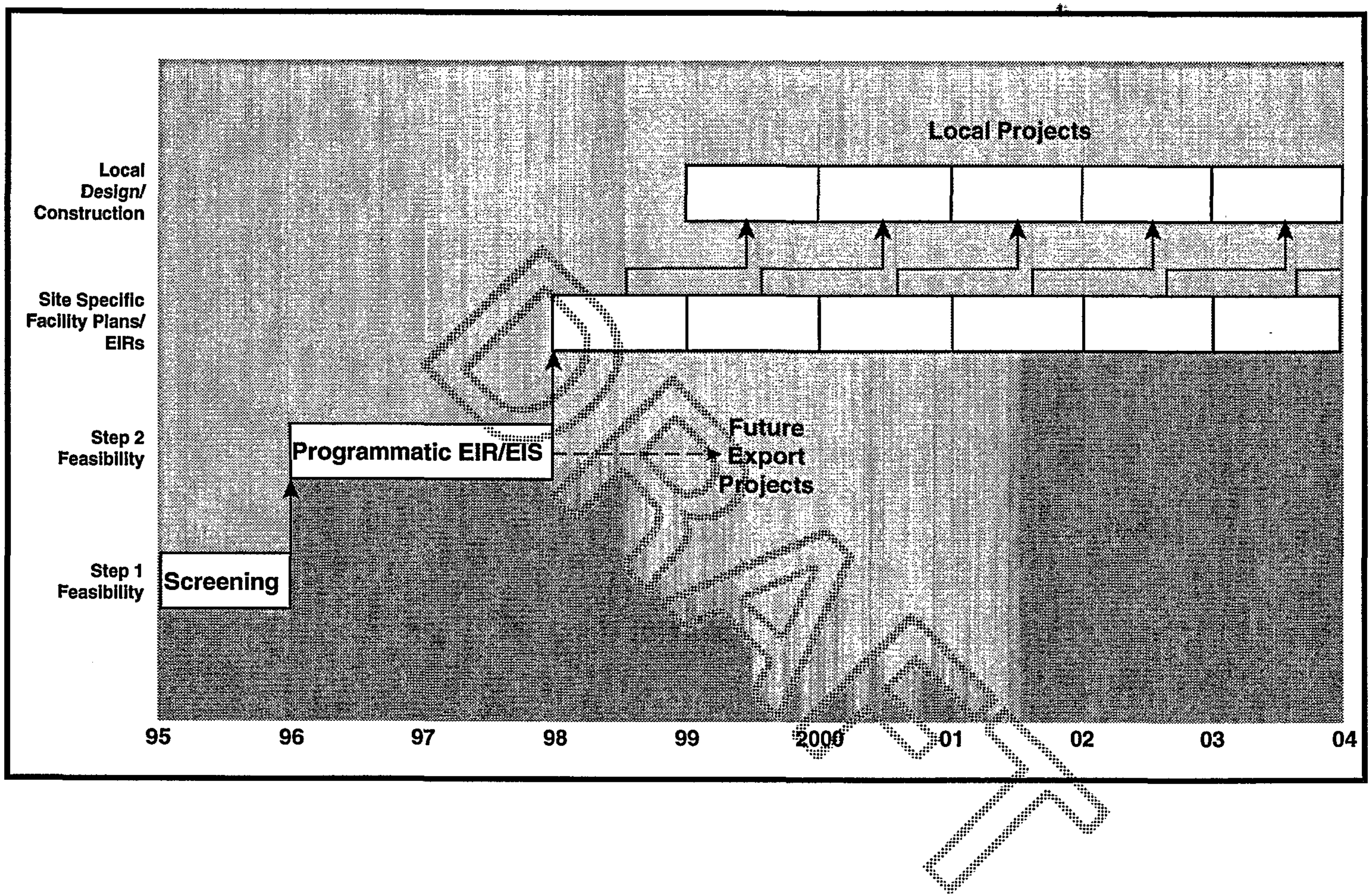

FIGURE ES-23
Short-Term Implementation of Regional Water Recycling Projects

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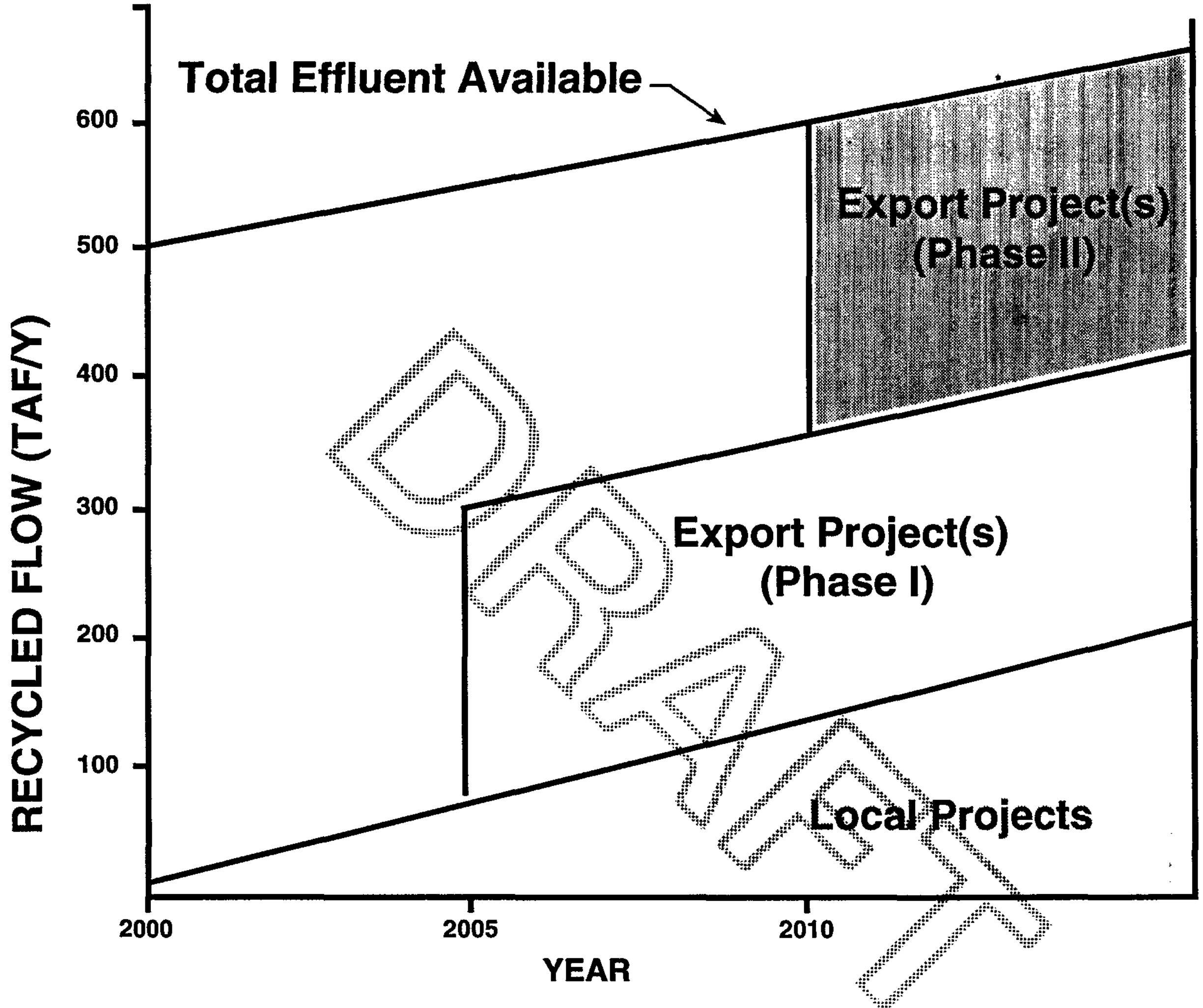

FIGURE ES-24
Possible Long-Term Implementation of Regional Water Recycling Projects